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Regional Tectonics and Seismicity of Eastern Nebraska

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Regional Tectonics and Seismicity of Eastern Nebraska

Annual Report
July 1979 - June 1980

Prepared by R. R. Burchett

Nebraska Geological Survey
University of Nebraska-Lincoln

Prepared for
U.S. Nuclear Regulatory
Commission

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Prepared by
R. R. Burchett

Nebraska Geological Survey
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
Lincoln, NE 68588

Prepared for
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
NRC FIN B5774

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ABSTRACT

This annual report presents and interprets the information obtained by the Conservation and Survey Division (Nebraska Geological Survey) during contract year July 1, 1979, to June 30, 1980, under contract NRC-04-76-315 with the U. S. Nuclear Regulatory Commission. The information pertains to the geology, structure, tectonics, and seismicity of eastern Nebraska with emphasis on the vicinity south of Omaha, Nebraska. Some of the information presented here results from a combination of studies begun in earlier years but the greater part results from studies begun during the contract year.

The scope of the studies is summarized as follows:

1. Rock outcrops in northeastern Cass, eastern Sarpy, and southeastern Douglas counties were reexamined and reevaluated, and 39 test holes were drilled to determine the altitude of the upper surface of the Winterset Limestone of Pennsylvanian age;
2. One new seismograph was installed in eastern Nebraska;
3. Gravity surveys in eastern Nebraska were extended;
4. Ground magnetic surveys in northeastern Cass and eastern Sarpy counties were made and evaluated.

Discussion of the results of these studies constitute the remainder of this report.

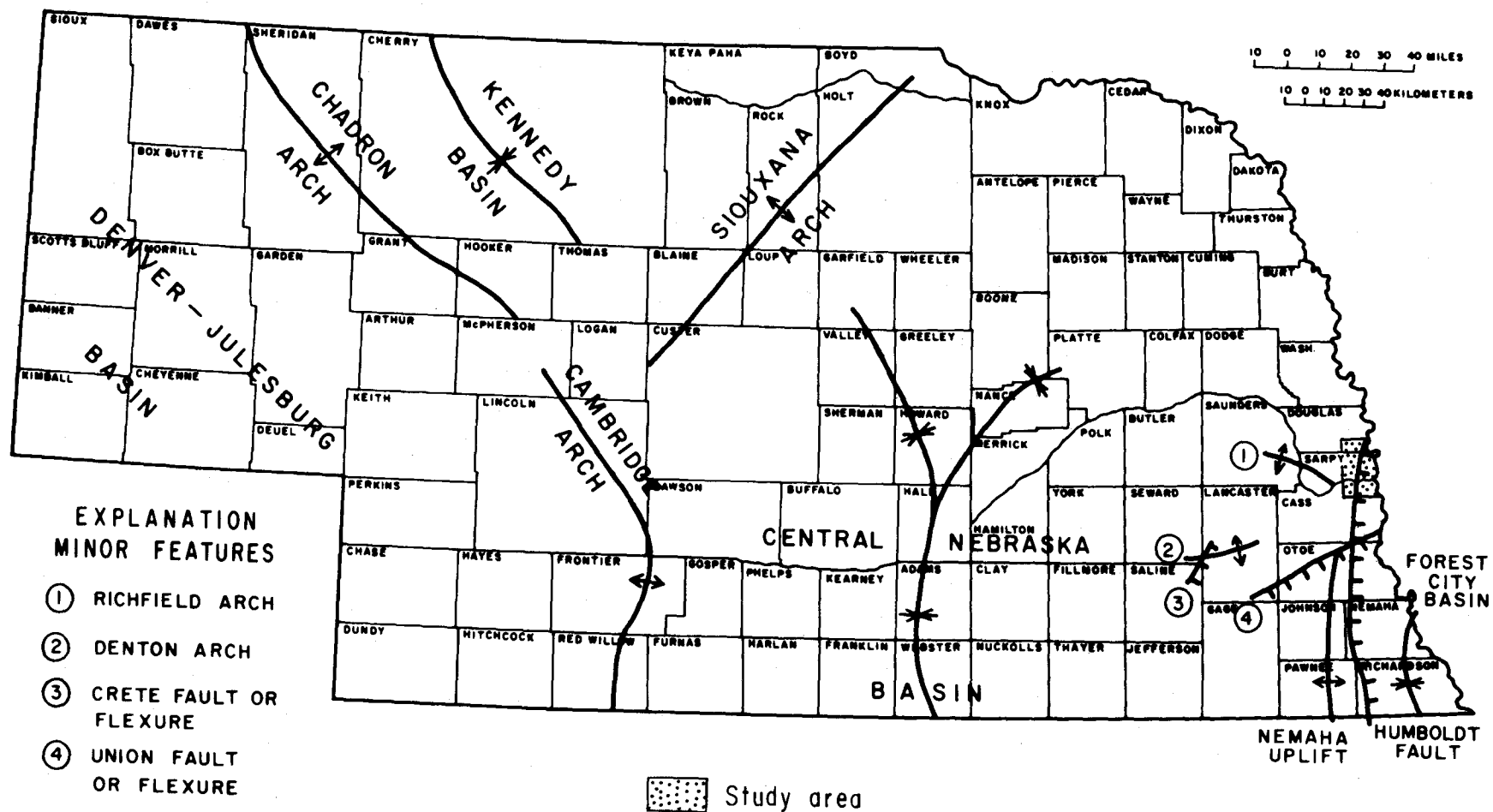
STRUCTURE OF THE WINTERSET LIMESTONE IN NORTHEASTERN CASS,
EASTERN SARPY, AND SOUTHEASTERN DOUGLAS COUNTIES, NEBRASKA.

R. R. Burchett

Introduction

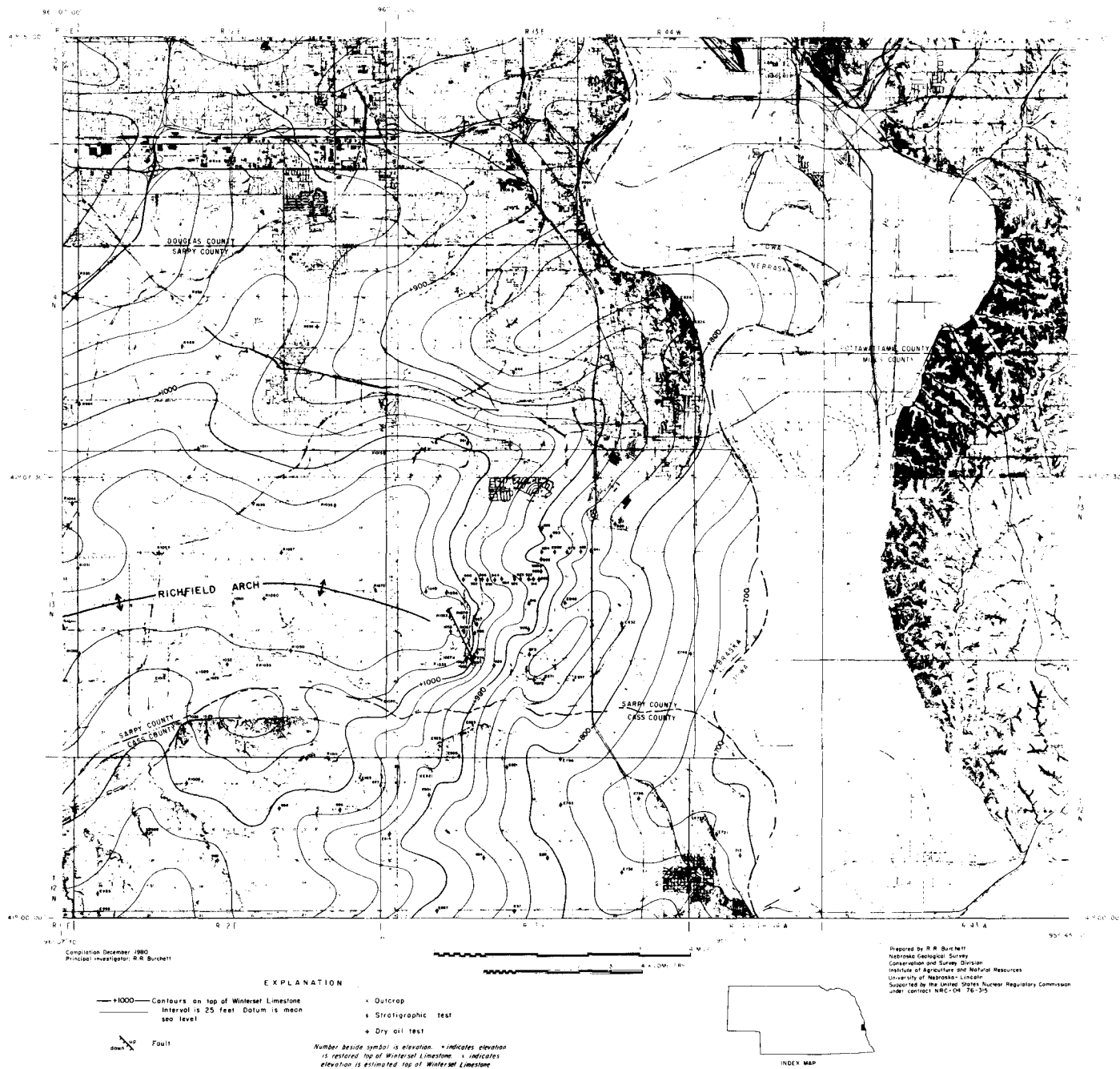
A specific site area south of Omaha, Nebraska was chosen for study in 1979-80 because it overlies the northern extension of the Humboldt Fault (fig. 1). Also this site was chosen because it encompasses an area surrounding the LaPlatte Fault-- a supposed Pennsylvanian age fault trending northeast-southwest and downfaulted on the east.

The primary purposes of this investigation were to acquire, by drilling test holes, subsurface data needed to correlate buried strata with strata that crop out and to gain a better understanding of buried structural features in eastern Nebraska. The top of the Winterset Limestone, a formation in the Kansas City Group of the Missouri Series of the Pennsylvanian System, was chosen as a datum plane for a structure map because the Winterset underlies most of the study area at a shallow depth and is easily identified in rock cuttings and cores obtained by drilling. All available data on the altitude of this surface in outcrops and in test holes were used as control points for contour lines depicting the configuration of the Winterset's upper surface (fig. 2).



PRINCIPAL STRUCTURAL FEATURES OF NEBRASKA (Carlson, 1970)

Figure 1



STRUCTURAL CONTOUR ON TOP OF THE WINTERSSET LIMESTONE IN
NORTHEASTERN CASS, EASTERN SARPY, AND SOUTHEASTERN DOUGLAS COUNTIES

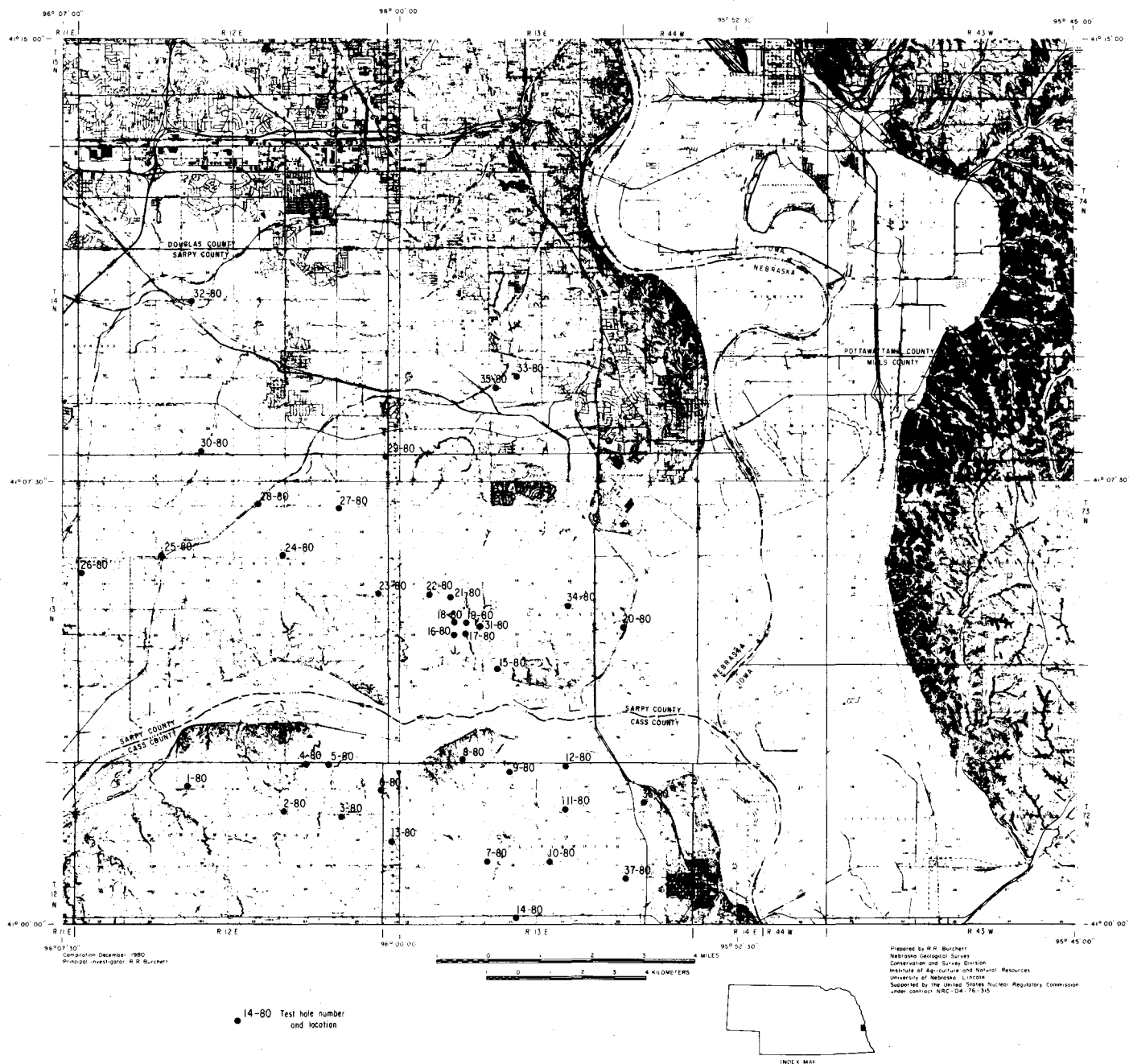
Figure 2

Scope of Investigation

Thirty-seven shallow rotary test holes were drilled in northeastern Cass and eastern Sarpy counties (fig. 3) by the Rieschick Drilling Company of Falls City, Nebraska. The holes averaged about 180 feet (54.9 m) in depth, and each was logged electically as well as thru visual examination of rock cuttings by Hans Ingold (part-time staff member of the Conservation and Survey Division). Some of the holes penetrated the Winterset Limestone; others were drilled to an identifiable horizon whose height above or depth below the Winterset is known, thus providing a Winterset datum. The holes were drilled in May and June of 1980 under a cooperative agreement between the Conservation and Survey Division (Nebraska Geological Survey) and the U.S. Nuclear Regulatory Commission (Contract NRC-04-76-315).

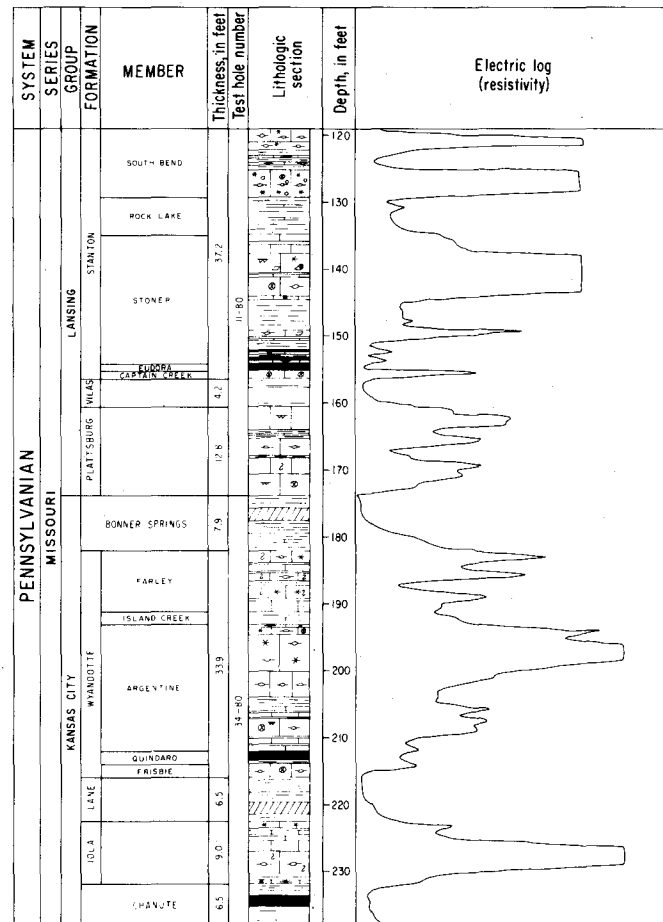
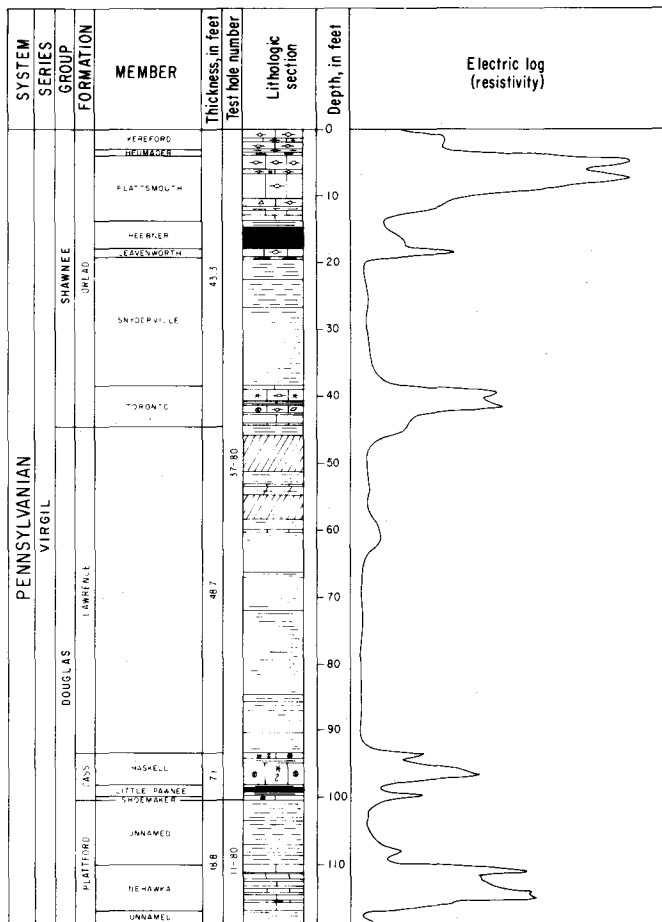
A binocular microscope was used for examination of the cuttings. Logs of the test holes, based on descriptions of the cuttings, are presented in Appendix A. Figures 4 and 5 show a composite section of the Pennsylvanian rocks drilled in the study area, together with a composite electric log of those rocks.

The geologic map illustrated in figure 6 shows the distribution of groups of Pennsylvanian age. Location of bedrock outcrops, mostly along valley sides, are shown in solid black. A careful reexamination of outcrops in the area provided additional data for mapping purposes. By determining the altitude of many outcrops, the investigators obtained additional vertical control points for the structure map.



LOCATION OF TEST HOLES DRILLED DURING 1980 IN NORTHEASTERN CASS AND EASTERN SARPY COUNTIES

Figure 3



KEY TO LITHOLOGY

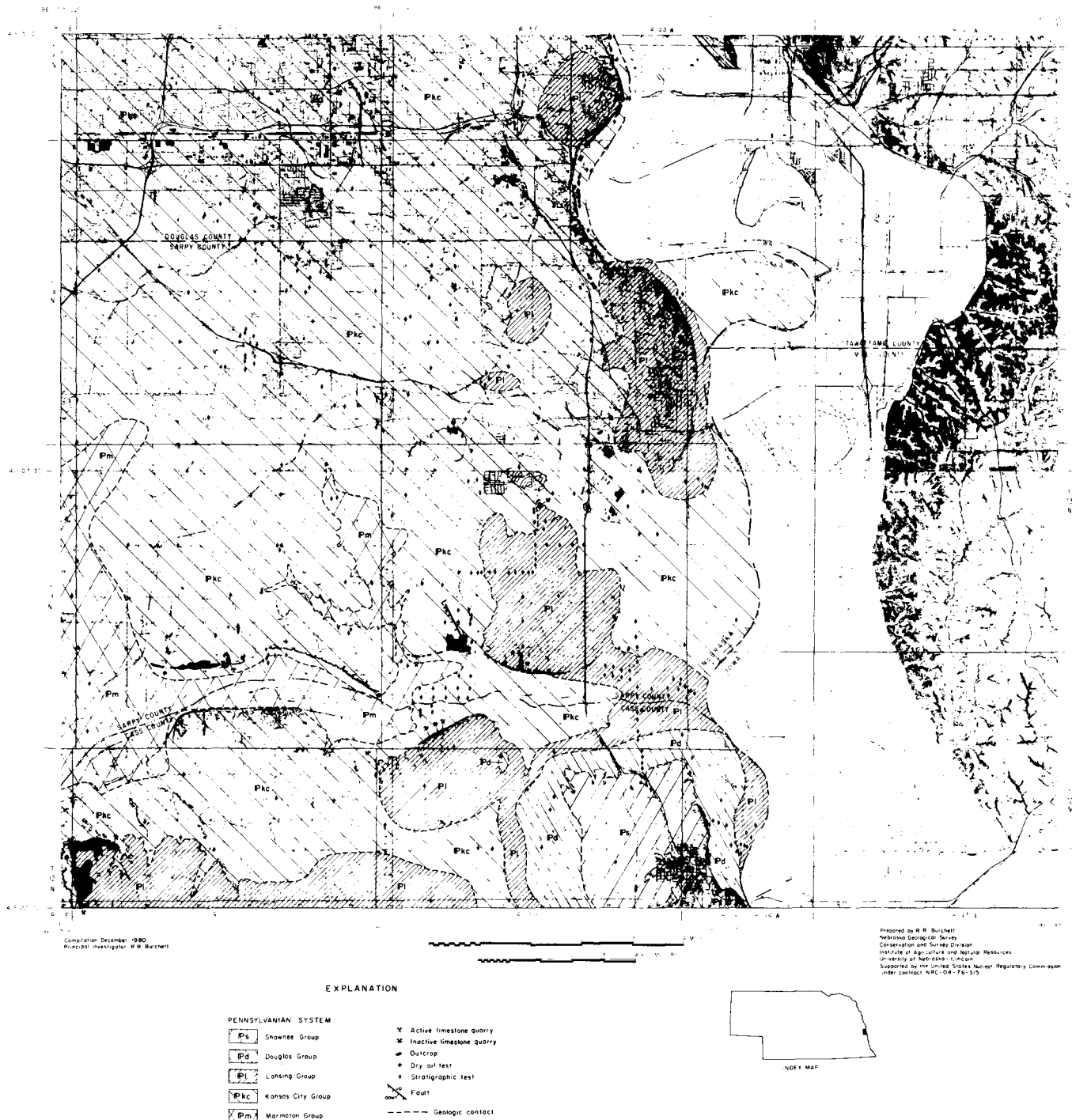
- LIMESTONE
- BLACK SHALE
- GREEN OR GRAY SHALE
- SANDSTONE
- RED SHALE

KEY TO SYMBOLS

- CHERT
- FUSULINES
- OOLITES
- PYRITE
- CRINOIDS
- CORALS
- GLAUCONITE
- BRACHIOPODS
- OSAGIA

COMPOSITE SECTION OF PENNSYLVANIAN ROCKS (LOWER VIRGIL AND UPPER MISSOURI SERIES)
DRILLED IN NORTHEASTERN CASS, EASTERN SARPY, AND SOUTHEASTERN DOUGLAS COUNTIES

Figure 4



GEOLOGY OF THE PENNSYLVANIAN SURFACE IN NORTHEASTERN CASS, EASTERN SARPY, AND SOUTHEASTERN DOUGLAS COUNTIES

Figure 6

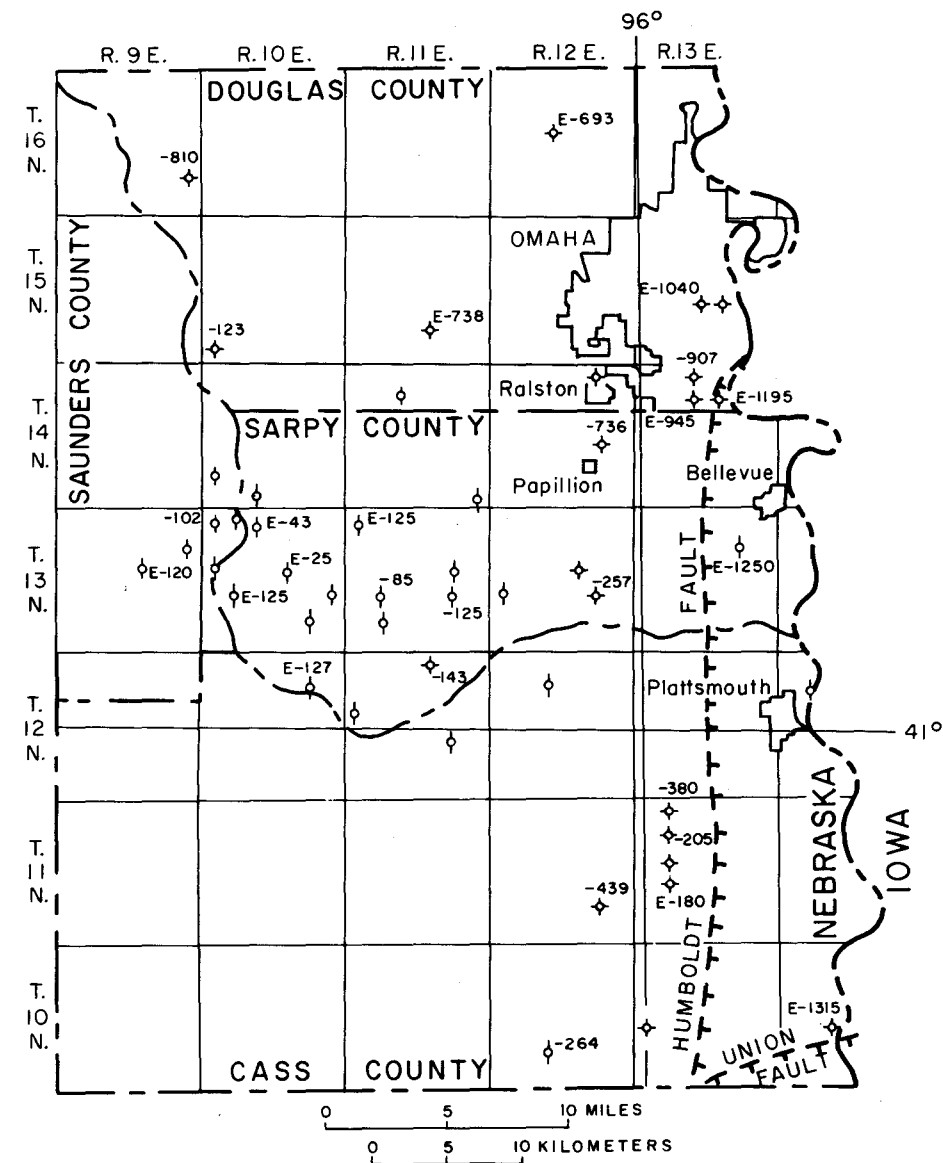
Most upland and lowland areas are mantled by unconsolidated Quaternary deposits such as loess, till, and alluvium. The maximum aggregate thickness of these deposits is 400 feet.

Results of Investigation

Interpretations based on drilling results and field observations during this investigation are summarized as follows:

1. The dominant structural feature of Pennsylvanian age, in the study area, is the Richfield Arch (fig. 2).
2. The altitude of the top of the Winterset Limestone (fig. 2) ranges from about 750 feet (228.6 m) above mean sea level in the southeastern part of the study area to more than 1050 feet (320 m) over the Richfield Arch.
3. The LaPlatte Fault which was previously interpreted from Pennsylvanian age rocks in the area is probably only moderate dip to the east-southeast
4. One small fault was observed in the study area in the eastern portion of the City Wide Rock Company quarry in the NE SW SW SE section 20, T. 13 N., R. 13 E., Sarpy County. The strike of this fault is approximately north 23° west with a dip of 66° to the southwest. Vertical displacement on the Winterset is 4.3 feet. Test hole drilling shows that the fault extends laterally to the northwest about $\frac{1}{2}$ mile from the quarry. Lateral extent of the fault to the southeast could not be determined. Drilling on the south side of the Platte River did not indicate that faulting continued. Overlying Quaternary deposits in the

- quarry were examined and no evidence of faulting was found.
5. Several deep drill holes have penetrated the Precambrian age rocks in Cass, Sarpy and Douglas counties. Locations of these holes and the elevation of the Precambrian surface are shown in figure 7.
 6. Faults and/or steep dips in the area probably reflect faulting and steep dips at depth. Deeper structures are indicated by contours drawn on the base of the Hertha Limestone, a formation in the Kansas City Group of the Missouri Series of the Pennsylvanian System (Burchett, 1978) and on the surface of Precambrian rocks (Carlson, 1967).
 7. Microearthquakes recently recorded in Kansas and Nebraska (see following chapter) suggest that the Humboldt Fault Zone is still slightly active. Past earthquakes of greater magnitude also may have been associated with movements in the same fault zone.



- up
down Zone of faulting or steep dip
 ♦ Deep drill hole
 ◊ Stratigraphic test
 Datum is mean sea level
 -264 Precambrian elevation determined by drilling
 E-127 Precambrian elevation estimated



ELEVATION OF PRECAMBRIAN SURFACE

Figure 7

References

- Burchett, R. R. 1978. Regional tectonics and seismicity of eastern Nebraska, Annual Report, June 1, 1976--June 1, Available from National Technical Service, Springfield, VA 22161.
- Carlson, M. P. 1967. Precambrian well data in Nebraska including rock type and surface configuration. Nebraska Geological Survey Bulletin 25. Lincoln, Nebraska: Conservation and Survey Division, University of Nebraska.
- Carlson, M. P. 1970. Distribution and subdivision of Precambrian and Lower and Middle Paleozoic rocks in the subsurface of Nebraska. Nebraska Geological Survey Report of Investigations 3. Lincoln, Nebraska: Conservation and Survey Division, University of Nebraska.

EARTHQUAKE MONITORING NETWORK IN NEBRASKA

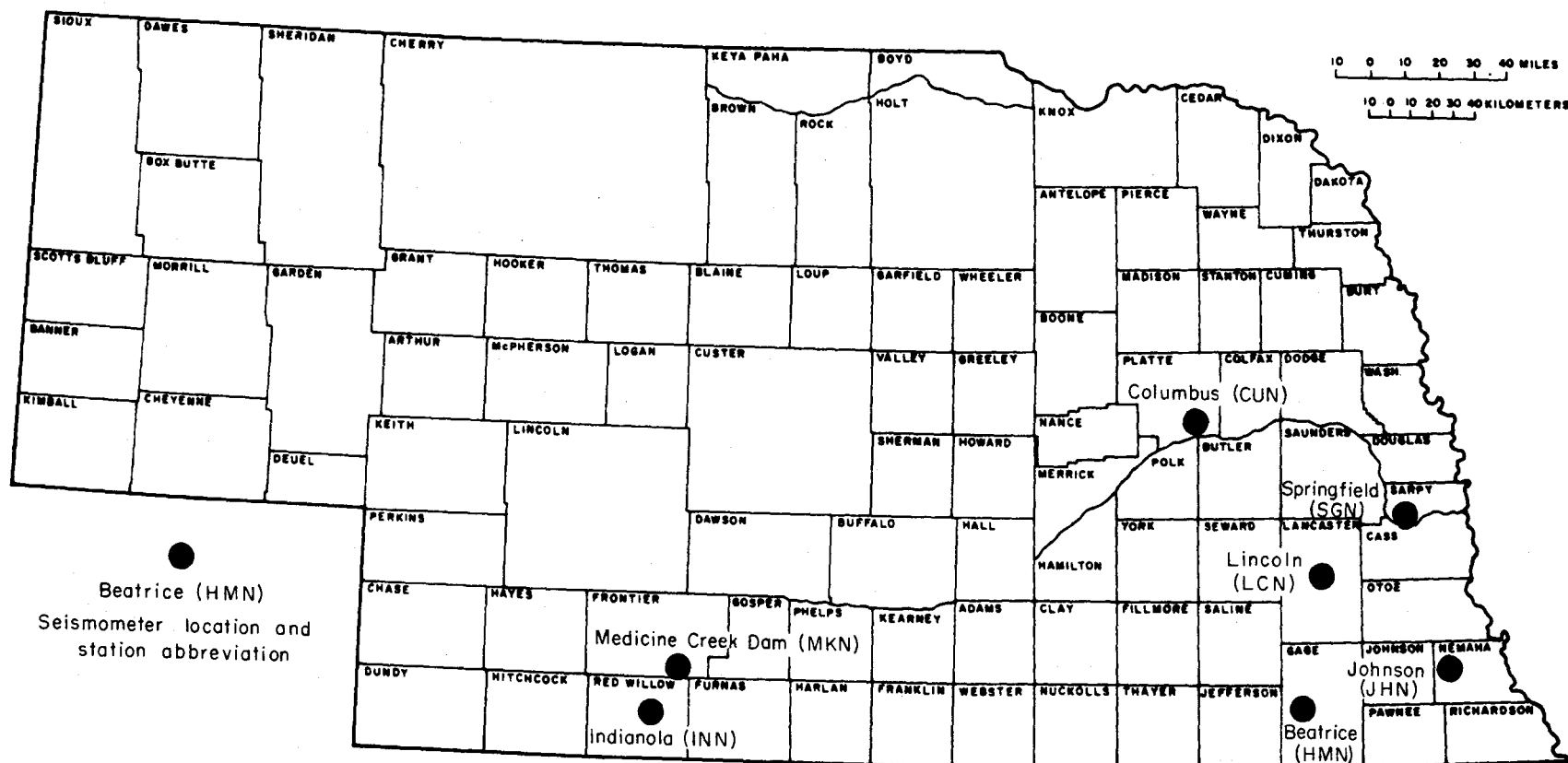
R. R. Burchett & Russell Smith

The Conservation and Survey Division (Nebraska Geological Survey) and the Geology Department of the University of Nebraska-Lincoln collaborated in the installation of a portable microearthquake station in Nebraska during contract year 1979-80. This station, near Springfield, was a replacement for the station near Gretna which developed high background noise. An additional station was installed during the year in southwestern Nebraska (Indianola) by the Kansas Geological Survey in cooperation with the University of Kansas Department of Geology.

As of July 1, 1980, a total of seven earthquake monitoring stations were operating in Nebraska. Locations of these stations are shown in figure 8. Precise location and other pertinent information about these stations are given below:

Site designation LCN. Location: E/2 NE NE SE sec. 23, T. 10 N., R. 6 E., lat. $40^{\circ} 48' 42''$ N., long. $96^{\circ} 42' 07''$ W.; on University of Nebraska-Lincoln campus at Lincoln in Lancaster County, Nebraska. Instrument altitude: 1,165 ft. (355 m) msl datum. Operation begun September 1, 1977.

Site designation CUN. Location: Center SL NE NW sec. 1, T. 17 N., R. 1 W.; lat. $41^{\circ} 28' 44''$ N., long. $97^{\circ} 22' 48''$ W.; on Platte Technical Community College campus near Columbus



LOCATION OF EARTHQUAKE MONITORING STATIONS IN NEBRASKA AS OF JULY 1, 1980

Figure 8

in Platte County, Nebraska. Instrument altitude: 1,530 ft. (466 m) msl datum. Operation begun July 12, 1978.

Site designation JHN. Location: NW corner SW NE sec. 36, T. 6 N., R. 12 E.; lat. $40^{\circ} 26' 49''$ N., long. $96^{\circ} 01' 03''$ W.; on Douglas Boellstorff farm near Johnson in Nemaha County, Nebraska. Instrument altitude: 1,080 ft. (329 m) msl datum. Operation begun December 5, 1978.

Site designation HMN. Location: NW SW SE NW sec. 26, T. 4 N., R. 5E.; lat. $40^{\circ} 17' 11''$ N., long. $96^{\circ} 50' 08''$ W.; on Homestead National Monument of America Site near Beatrice in Gage County, Nebraska. Instrument altitude: 1,207 ft. (368 m) msl datum. Operation begun June 20, 1979.

Site designation SGN. Location: SE NW NE SE sec. 30, T. 13 N., R. 11 E.; lat. $41^{\circ} 3' 57''$ N., long. $96^{\circ} 13' 7''$ W.; on Leroy Nielson farm near Springfield in Sarpy County, Nebraska. Instrument altitude: 1,140 ft. (348 m) msl datum. Operation begun June 20, 1980.

Site designation MKN. Location: NW SE NW sec. 25, T. 5 N., R. 26 W.; lat. $40^{\circ} 22.44'$ N., $100^{\circ} 13.50'$ W.; near Medicine Creek Dam in Frontier County, Nebraska. Instrument altitude 2,395 ft. (730 m) msl datum. Operation begun March 11, 1979.

Site designation INN. Location: NW SW SW sec. 29, T. 3 N., R. 27 W.; lat. $40^{\circ} 11.55'$ N., $100^{\circ} 24.01'$ W.; near Indianola in Red Willow County, Nebraska. Instrument altitude 2,500 ft. (762 m) msl datum. Operation begun September 15, 1979.

All stations are equipped with Geotech Portacorders model RV-320 and Geotech model S-13 seismometers except the HMN and

MKN stations are equipped with Geotech model S-500 seismometers and INN with a GSC-20D seismometer.

Each station is operated by a volunteer who agreed to (1) permit installation of a seismometer vault on his property, (2) provide housing for the amplifier-filter-recorder-clock system and the WWV time-signal radio receiver, and (3) change the seismograph recorder charts, replenish the ink supply, and reset the clock whenever necessary on a 365-day-per-year basis. All seismographic records with the exception of Medicine Creek and Indianola are sent to the University of Nebraska-Lincoln for preliminary analysis and then are forwarded to the Kansas Survey for more detailed analysis. The seismographic records from Medicine Creek and Indianola are sent directly to the Kansas Geological Survey.

The Nebraska seismometers, together with seismometers in the adjacent part of Kansas, provide continuous coverage of seismic activity along the buried Nemaha Ridge.

Twenty-five microearthquakes centering in Nebraska were recorded between August 1977 and July 1980. Table 1 and figure 9 show the location of these microearthquakes.

TABLE 1

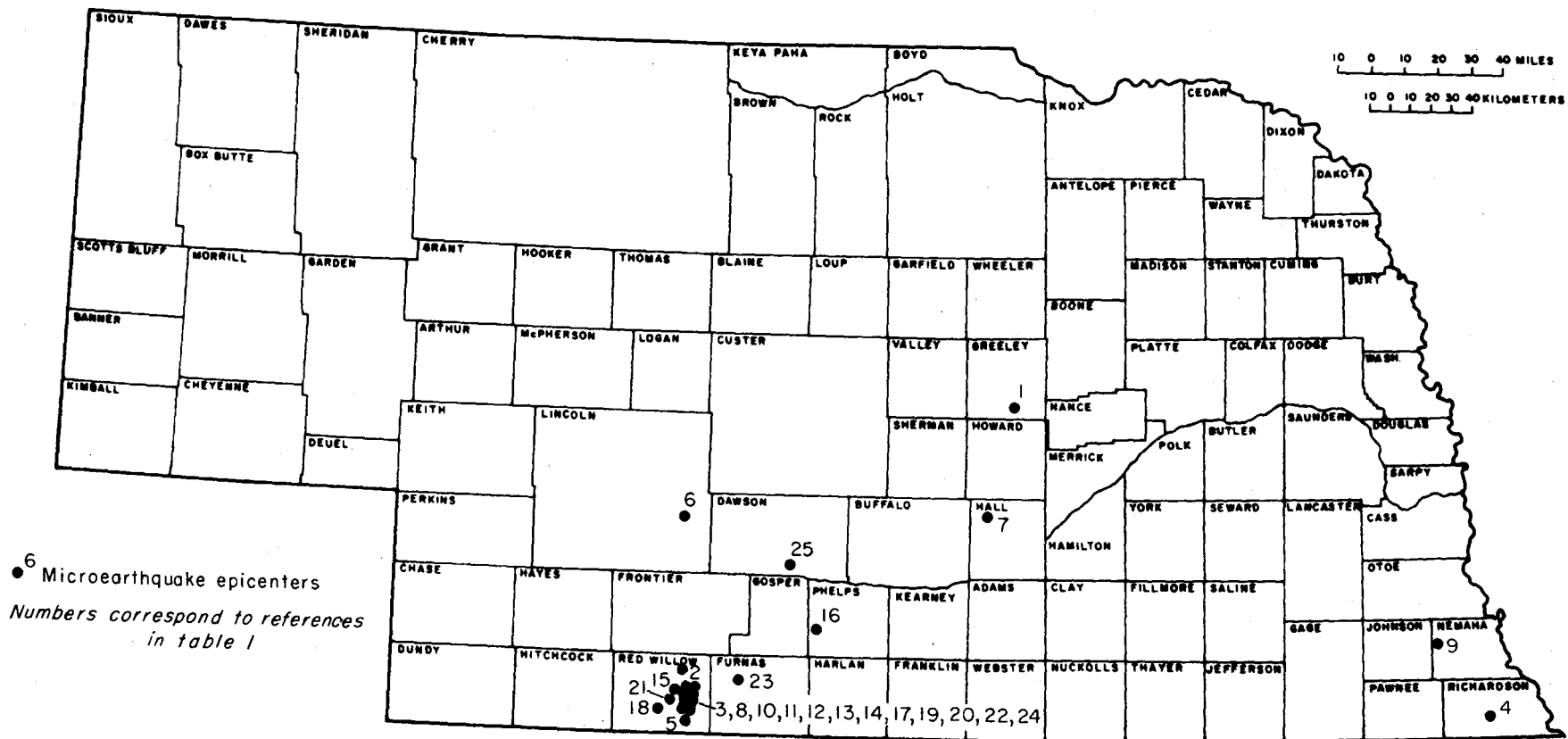
MICROEARTHQUAKES IN NEBRASKA

Map Ref.	Date	Origin Time (UTC) ¹	Latitude Degrees North	Longitude Degrees West	Depth ² (Km)	Magnitude ³
1	1977 Aug 18	10:34:25.21	41:24.90	98:28.07	5.00	2.5
2	1977 Dec 1	13:04:34.20	40:18.53	100:22.00	5.00	2.3
3	1977 Dec 1	13:22:38.57	40:12.52	100:17.87	5.00	2.4
4	1978 Jan 13	20:15:33.39	40:05.58	95:42.00	5.00	1.7
5	1978 Feb 3	0:25:47.62	40:01.92	100:20.00	5.00	2.4
6	1978 Sep 14	8:06:18.59	40:53.76	100:22.00	5.00	2.2
7	1979 Apr 8	22:46:10.41	40:58.12	98:33.83	0.67	2.4
8	1979 Jun 6	16:16:21.91	40:08.61	100:20.88	1.00	2.5
9	1979 Jun 12	11:13:11.88	40:24.33	96:03.26	2.07	1.8
10	1979 Jul 16	0:03:48.18	40:10.07	100:17.22	5.00	2.7
11	1979 Jul 16	1:34:20.32	40:11.59	100:20.70	5.00	2.5
12	1979 Jul 16	5:27:01.42	40:11.45	100:20.00	9.08	1.3
13	1979 Jul 16	6:08:09.89	40:11.32	100:20.73	11.09	1.5
14	1979 Jul 16	7:05:56.02	40:12.00	100:19.90	7.08	1.1
15	1979 Jul 24	4:16:46.09	40:12.47	100:26.00	0.88	2.2
16	1979 Jul 24	8:04:46.26	40:27.94	99:37.38	0.87	1.9
17	1979 Aug 2	4:16:21.66	40:10.34	100:21.44	0.84	2.5
18	1979 Aug 13	11:09:47.65	40:06.80	100:30.10	1.50	1.7
19	1979 Aug 14	23:59:31.37	40:10.39	100:20.58	1.76	1.5
20	1979 Aug 15	6:45:53.87	40:08.68	100:20.34	1.51	1.5
21	1979 Aug 15	16:07:07.14	40:08.49	100:26.43	1.23	1.3
22	1979 Aug 31	8:00:11.70	40:08.31	100:20.22	1.53	2.2
23	1979 Nov 19	4:58:43.40	40:14.86	100:02.77	13.57	1.5
24	1979 Nov 29	22:02:31.21	40:09.80	100:21.64	3.15	1.9
25	1980 Apr 26	14:21:48.50	40:43.99	99:43.91	5.00	2.3

¹(UTC) Coordinated Universal Time.--Subtract 6 hours for Central Standard Time.

²Depth calculated in kilometers or fixed at 5.00 km.

³Duration magnitude calculated from equation derived by Oklahoma Geological Observatory.



MICROEARTHQUAKES IN NEBRASKA

Figure 9

GRAVITY AND GROUND MAGNETIC INVESTIGATIONS IN EASTERN NEBRASKA

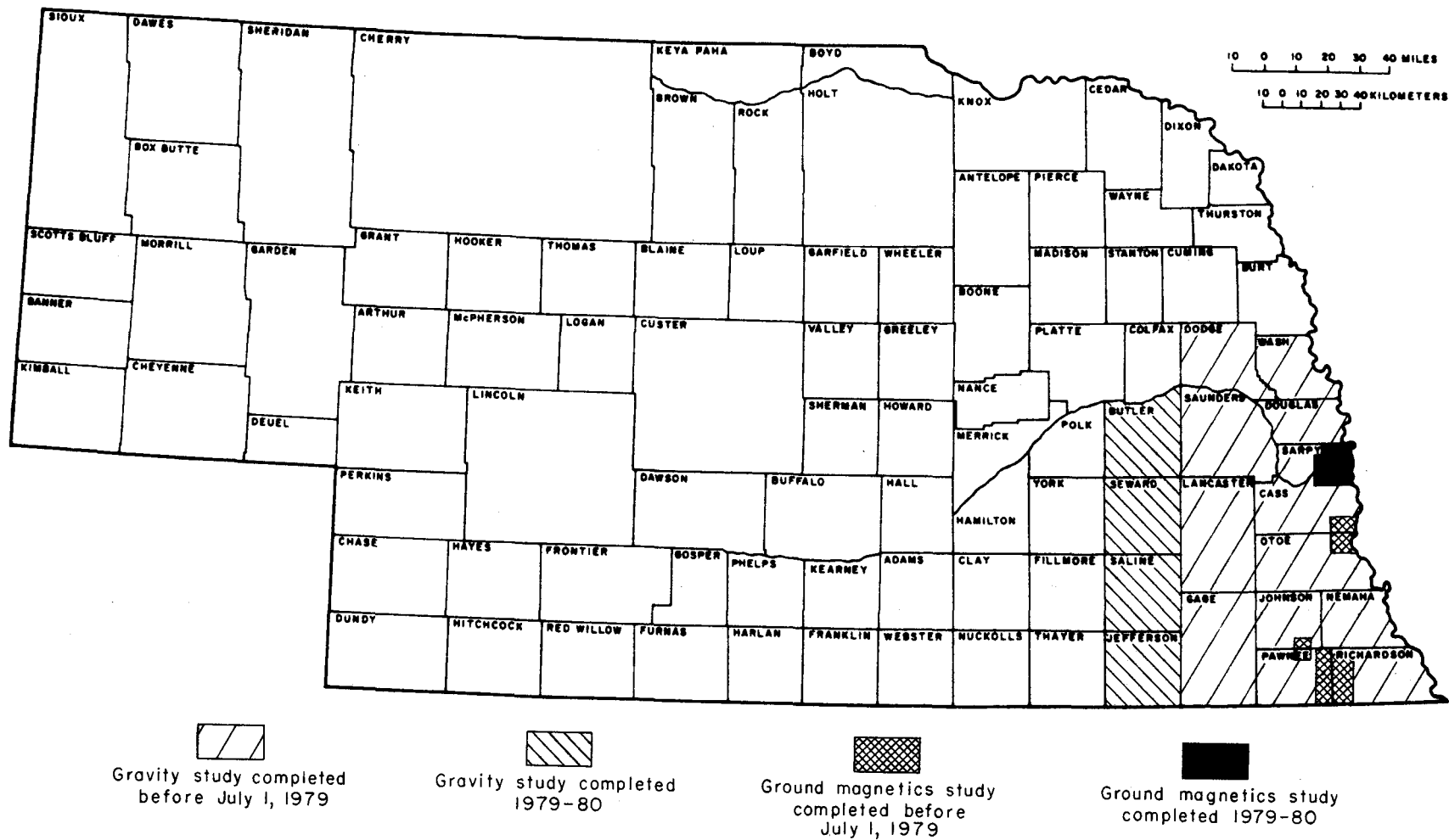
R. F. Diffendal, Jr. and R. R. Burchett

Introduction

The purpose of this investigation was to extend the area covered by gravity and ground magnetic data related to the Nemaha Uplift and associated structures in eastern Nebraska (fig. 10). Gravity data were collected from Butler, Jefferson, Saline, and Seward counties. Additional ground magnetic data and gravity data were collected for eastern Sarpy and north-eastern Cass counties in Nebraska and gravity data were collected from parts of Mills and Fremont counties in Iowa.

Gravity Study

Gravimetric surveying is a geophysical technique that aids in interpretation of subsurface geologic structure. A Worden Master, a very sensitive weighing device, which measures differences in gravity intensity (acceleration) at specific points on the earth's surface, is used in this type of surveying. The principal causes of gravity anomalies generally are either the dissimilar compositions of crystalline basement rocks and overlying sedimentary rocks or density contrasts produced by vertical or horizontal displacements of rocks. However, other phenomena also can contribute to differences in gravity intensity and in combination with the principal causes can make gravity data somewhat ambiguous.



LOCATIONS OF GRAVITY AND MAGNETIC STUDIES IN EASTERN NEBRASKA

Figure 10

All gravity base stations in the Nebraska Gravity Network are tied to the National Gravity Network base station located at the Lincoln Municipal Airport. Gravity stations established during this study were located at section corners and in some cases half-mile section lines (fig. 11). Land-surface altitudes at most stations could be determined directly from 7.5-minute topographic quadrangles. For other stations, land-surface altitudes were estimated from topographic contours and are accurate within ± 2 feet.

Field gravity data were corrected for latitude, meter drift and elevation; earth tides were not considered. The maximum error in station altitudes was enough to produce variations of ± 0.2 milligal. Slight inaccuracies in station locations--none greater than 0.1 minute of latitude--could have produced errors of no more than ± 0.08 milligal. A ± 0.02 milligal error was possible from either tidal or instrumental sources. Therefore, the maximum possible was ± 0.3 milligal but generally was much less because some errors were compensatory.

Bouguer values were calculated from assumed computational density values of 2.5, 2.6, and 2.67 gm/cm³. The average density value of 2.69 gm/cm³ obtained by Muehlberger and others (1964) for two samples of Precambrian crystalline rocks indicated that 2.67 gm/cm³ would be the most realistic Bouguer computational density value.

In Sarpy and northeastern Cass counties in Nebraska and in Mills and Fremont counties in Iowa about 169 gravity stations, in addition to those previously established, were used to produce

LOCATION OF BOUGUER GRAVITY STATIONS IN EASTERN NEBRASKA

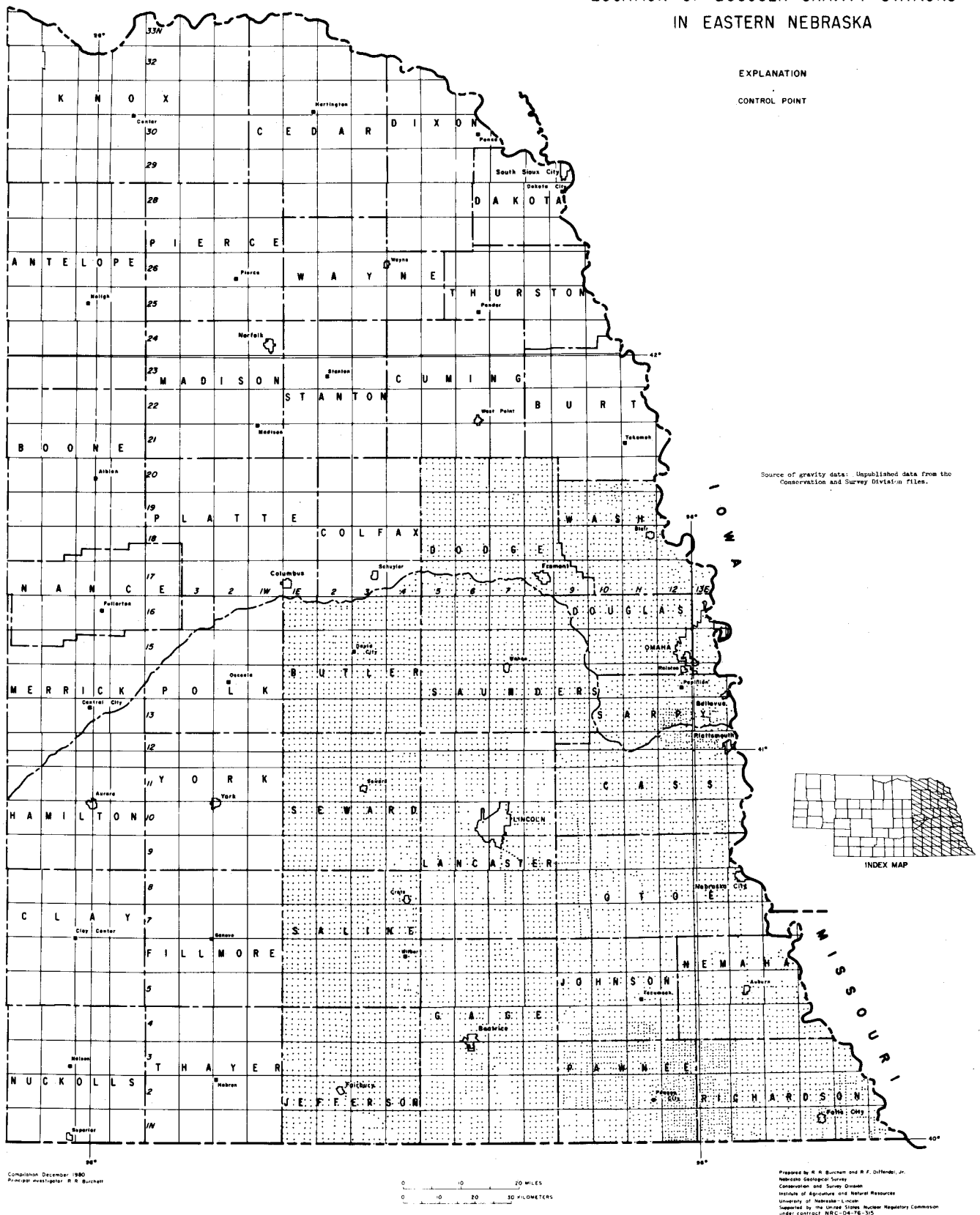


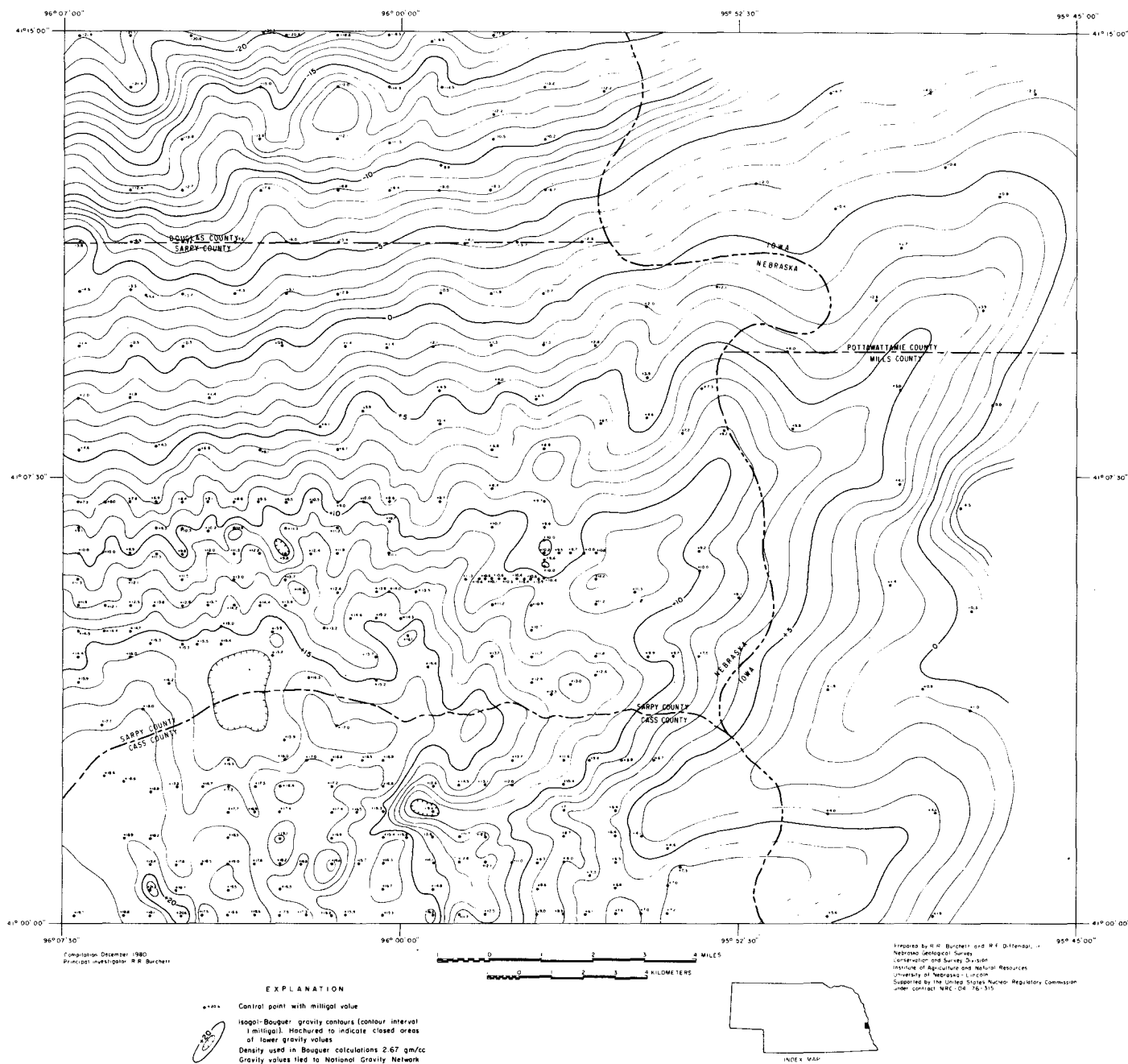
Figure 11

a hand-contoured Bouger gravity map (fig. 12). In addition about 2231 gravity stations were occupied in Butler (fig. 13), Jefferson (fig. 14), Saline (fig. 15), and Seward counties (fig. 16). Data collected at these stations were used to produce Bouguer gravity maps for each of the counties (figs. 17, 18, 19, & 20). These data were also integrated with previously collected data to generate a comprehensive regional Bouguer gravity map of eastern Nebraska (fig. 21).

Ground Magnetic Study

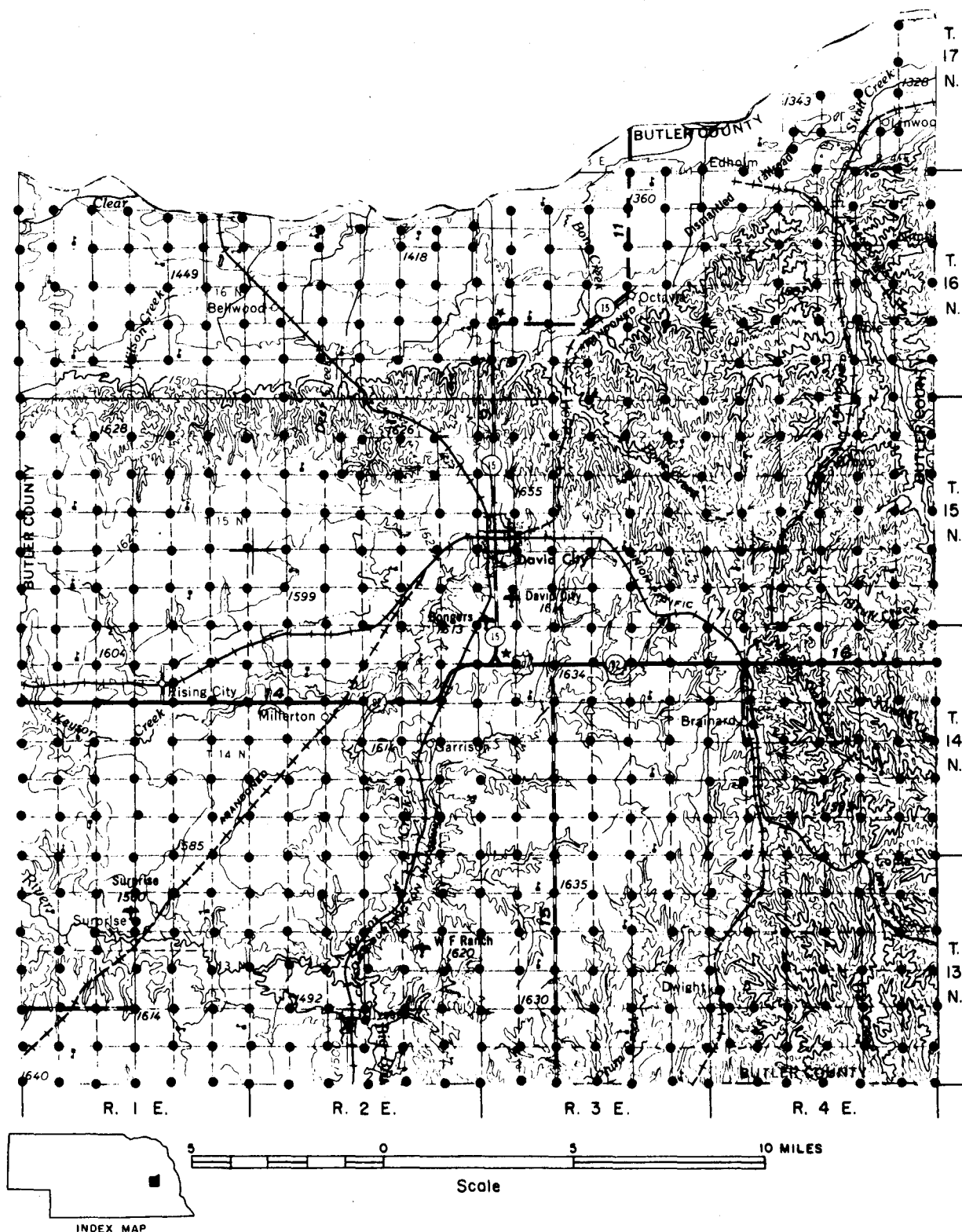
The instrument used in the ground magnetic survey was a Geometrics^R 826 Proton Magnetometer. This instrument measures the total magnetic field with an accuracy of ± 1 gamma. Magnetic anomalies are produced by differences in the degree of rock magnetization (polarization). Although, to a large extent, magnetic intensity is related directly to the percentage of the mineral magnetite in rocks, depth to the magnetic source rocks is another variable that affects the measurements.

During field operations about 335 magnetic stations were established at 0.5- and 1.0- mile spacings in Sarpy and north-eastern Cass counties. Sites selected as magnetic stations were well-removed from artificial magnetic sources such as fences, power lines, and pipelines. Corrections for diurnal magnetic drift were made by making observations at a base station at 3-hour intervals and then using those observations to correct, by linear interpolation, the readings made at field stations between base stations. No corrections were made for latitude.



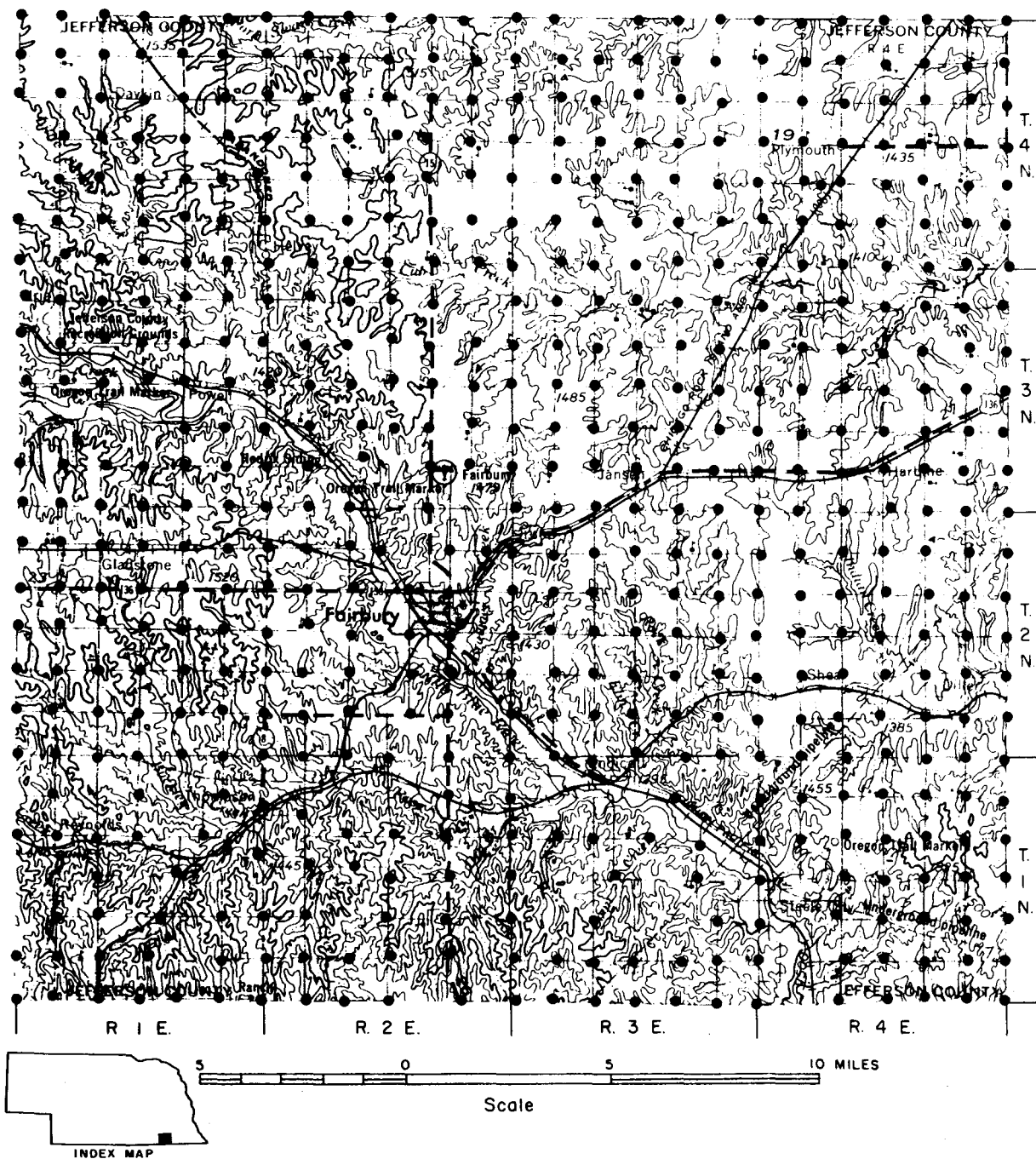
BOUGUER GRAVITY OF NORTHEASTERN CASS, EASTERN SARPY, SOUTHEASTERN DOUGLAS COUNTIES, NEBRASKA
AND ADJACENT PORTIONS OF IOWA

Figure 12



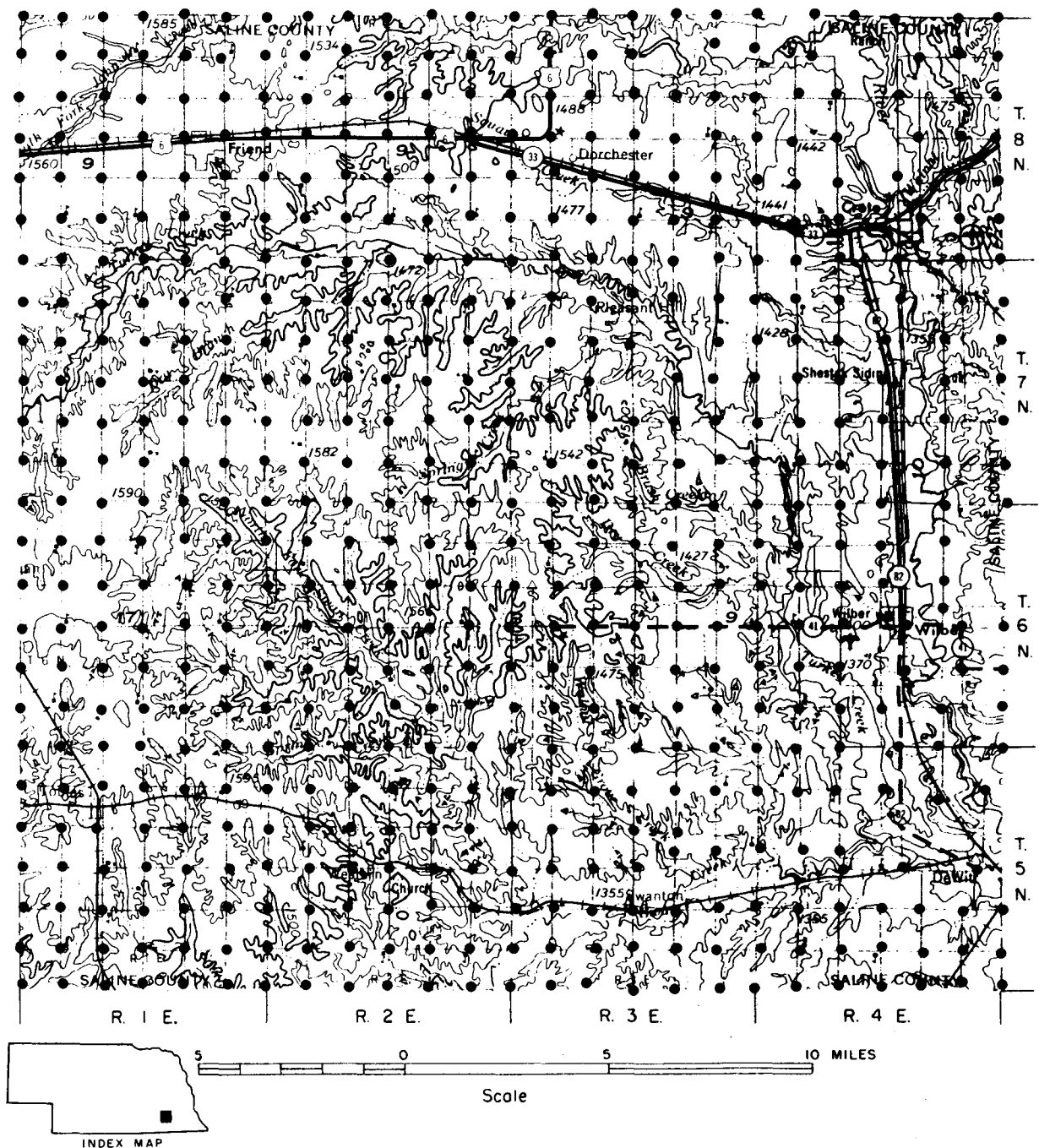
LOCATION OF BOUGUER GRAVITY STATIONS IN BUTLER COUNTY

Figure 13



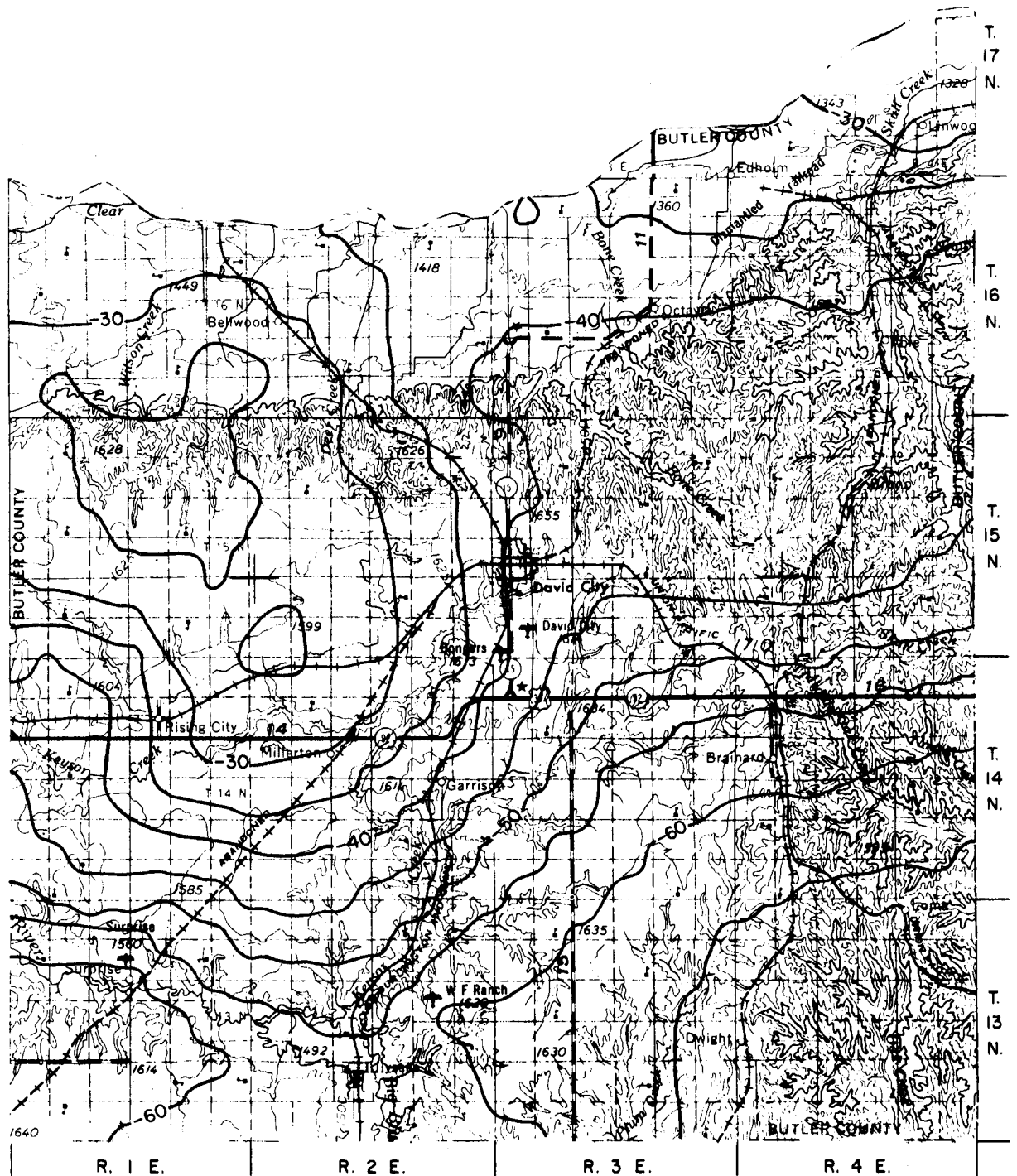
LOCATION OF BOUGUER GRAVITY STATIONS IN JEFFERSON COUNTY

Figure 14



LOCATION OF BOUGUER GRAVITY STATIONS IN SALINE COUNTY

Figure 15

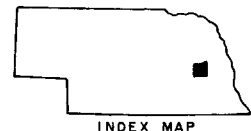


5 0 5 10 MILES

Scale



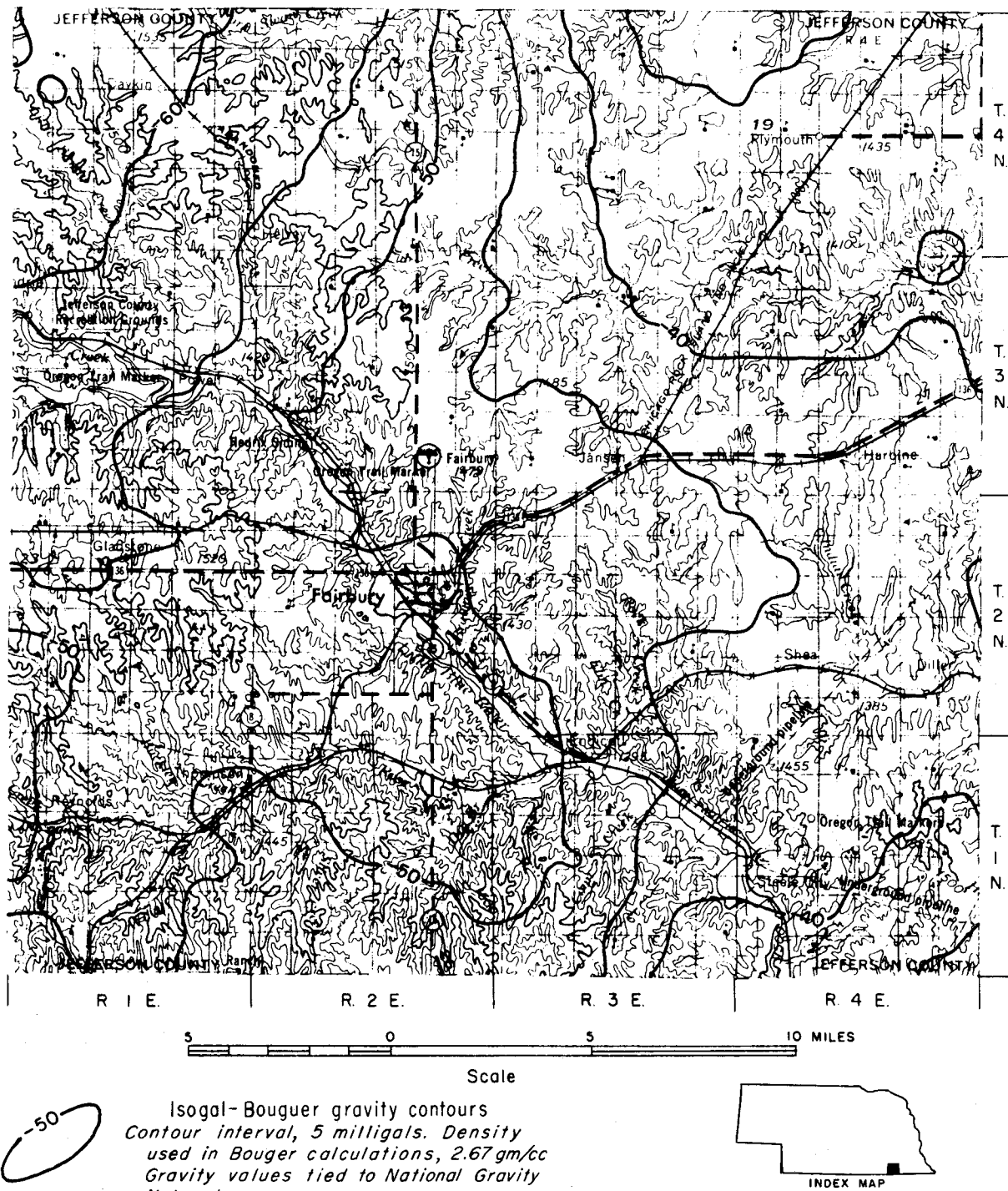
Isogal-Bouguer gravity contours
Contour interval, 5 milligals. Density
used in Bouguer calculations, 2.67 gm/cc
Gravity values tied to National Gravity
Network



INDEX MAP

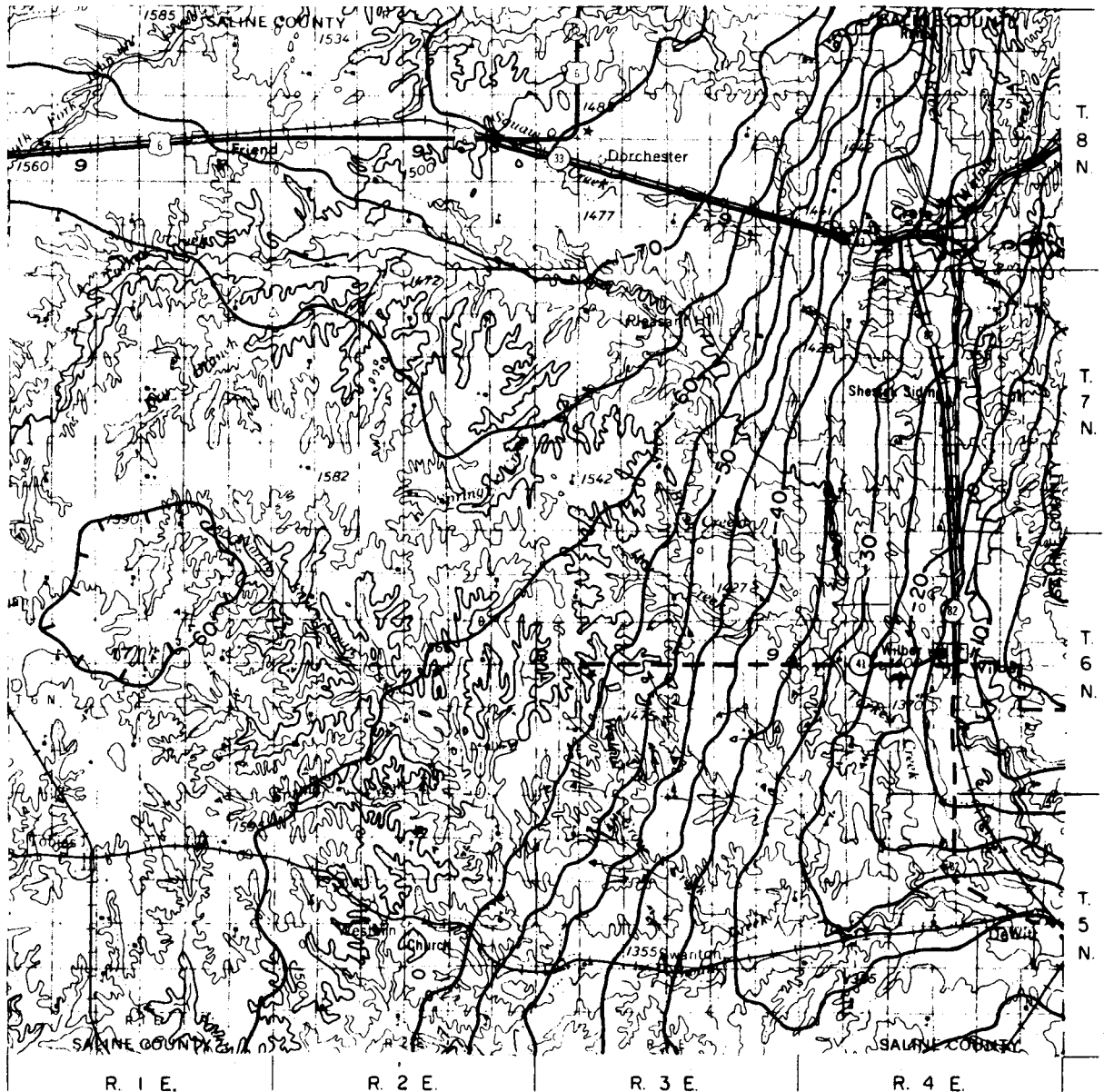
BOUGUER GRAVITY OF BUTLER COUNTY

Figure 17



BOUGUER GRAVITY OF JEFFERSON COUNTY

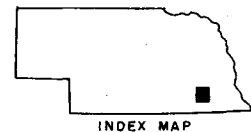
Figure 18



Scale



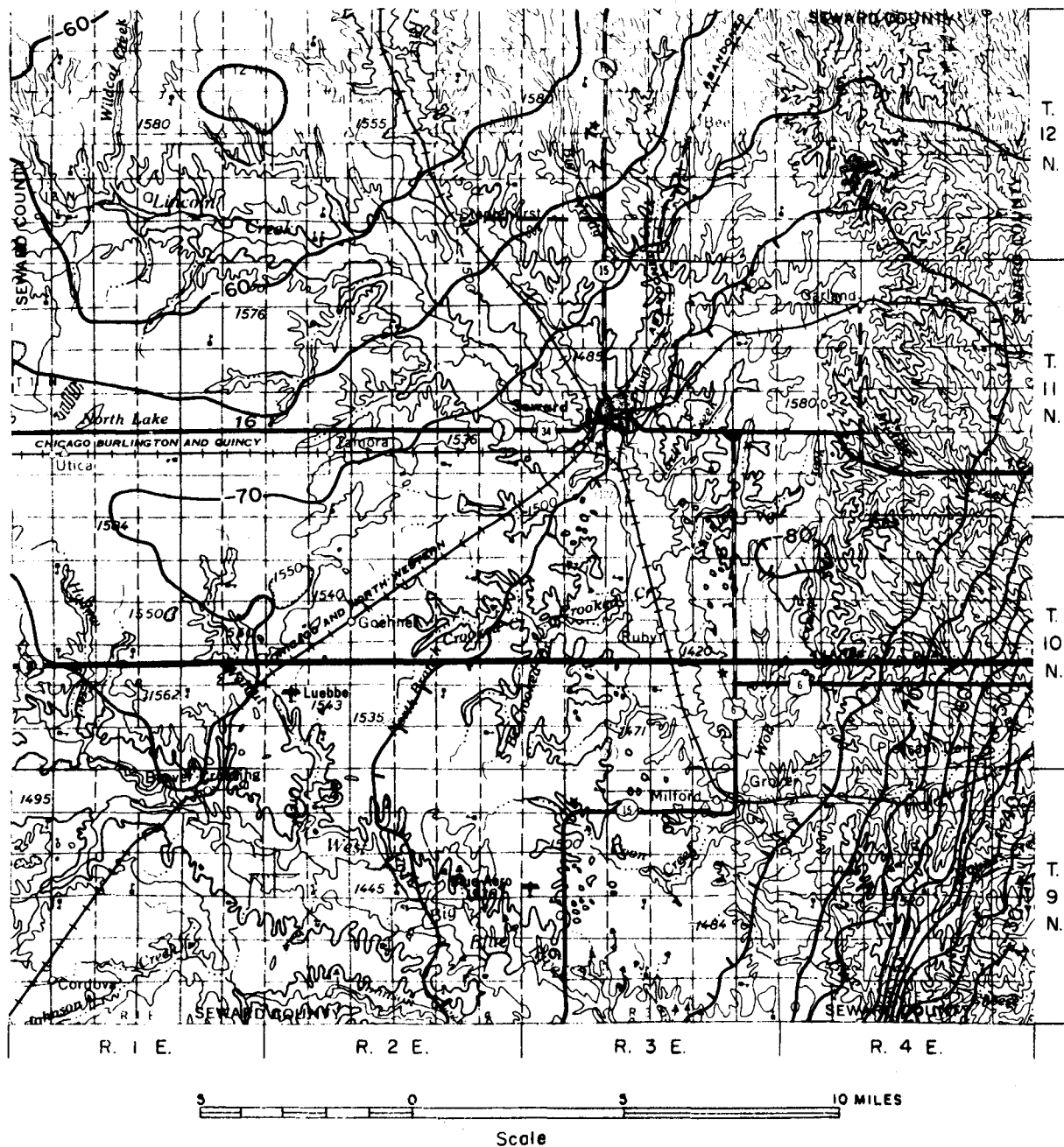
Isogal-Bouguer gravity contours
 Contour interval, 5 milligals. Hachures
 indicate closed area of lower gravity
 values. Density used in Bouguer
 calculations, 2.67 gm/cc. Gravity values
 tied to National Gravity Network



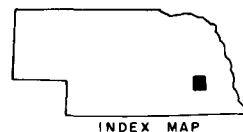
INDEX MAP

BOUGUER GRAVITY OF SALINE COUNTY

Figure 19



Isogal-Bouguer gravity contours
 Contour interval, 5 milligals. Hachures
 indicate closed areas of lower gravity
 values. Density used in Bouguer
 calculations, 2.67 gm/cc. Gravity values
 tied to National Gravity Network



BOUGUER GRAVITY OF SEWARD COUNTY

Figure 20

BOUGUER GRAVITY ANOMALY MAP IN EASTERN NEBRASKA

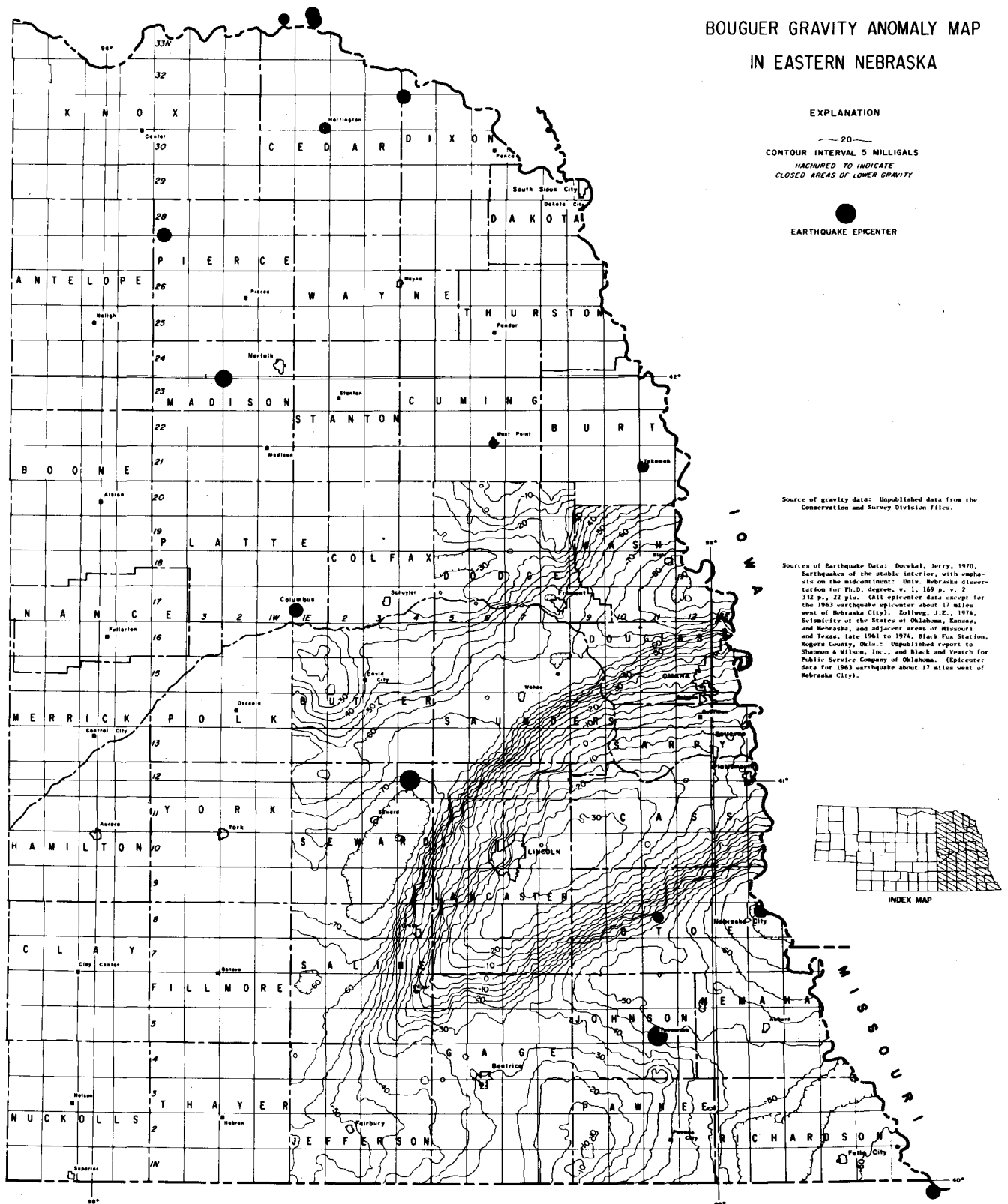
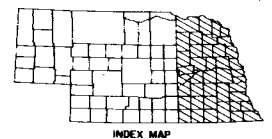
EXPLANATION

— 20 —
CONTOUR INTERVAL 5 MILLIGALS
HACHURED TO INDICATE
CLOSED AREAS OF LOWER GRAVITY

●
EARTHQUAKE EPICENTER

Source of gravity data: Unpublished data from the
Conservation and Survey Division files.

Source of Earthquake Data: Bowkai, Jerry, 1970,
Earthquakes of the stable interior, with emphasis
on the midcontinent: Univ. Nebraska disserta-
tion for Ph.D. degree, v. 1, 189 p. v. 2
132 p., 22 pls. (all epicenter data except for
the 1963 earthquake epicenter about 17 miles
west of Nebraska City). Zolty, J.E., 1974,
Seismicity of the States of Oklahoma, Kansas,
and Nebraska, and adjacent areas of Missouri
and Texas, late 1961 to 1974, Black Fox Station,
Rogers County, Okla.: Unpublished report to
Shannon & Wilson, Inc., and Black and Veatch for
Public Service Company of Oklahoma. (Epicenter
data for 1963 earthquake about 17 miles west of
Nebraska City).



Compilation December 1980
Principal investigator: R. B. Burgett

0 10 20 MILES
0 10 20 30 KILOMETERS

Prepared by R. B. Burgett and R. T. D'Amico, Jr.
Nebraska Geological Survey,
Conservation and Survey Division
Ministry of Agriculture and Natural Resources
University of Nebraska-Lincoln
Supported by the United States Nuclear Regulatory Commission
under contract NRC-04-76-575

Figure 21

The final magnetic intensity data were contoured by hand (fig. 22).

References

Muehlberger, W. R., Denison, R. E., and Lidiak, E. G. 1964.

Buried basements rocks of the United States of America
and Canada: Final Report, Appendix to vol. II, contract
AF49(638)-1115/ARPA Order No. 180-62. Univ. Texas, Austin.

APPENDIX A

This appendix consists of descriptions of the thirty-seven test holes drilled in northeastern Cass and eastern Sarpy counties. All locations are shown in figure 3 of the text.

All measurements in this appendix are expressed in feet. To convert to the International System of Units, multiply feet by .3048 to obtain meters.

Test Hole 1-80

Location: Cass County, center of south line, SE SW NW sec. 4,
T. 12 N., R. 12 E., approximately 21 feet north of
half section line and 1000 feet east of west section
line.

Ground-level elevation: 1068.0 feet above mean sea level.

Started: May 19, 1980. Completed: May 19, 1980.

Total depth: 167.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 7.0
Silt, yellowish brown.....	7.0	- 16.0
Silt, yellowish brown, clayey.....	16.0	- 27.0
Silt, light yellowish brown.....	27.0	- 29.0
Silt, pale yellow; contains iron stone concretions.....	29.0	- 32.0
Clay, pale olive.....	32.0	- 37.0
Silt, medium brown.....	37.0	- 47.0
Sand, very fine to very coarse; contains some gravel, fine.....	47.0	- 48.0
Silt, medium brown.....	48.0	- 60.0
Silt, yellowish brown with pale red mottling, clayey.....	60.0	- 66.0
Sand, very fine to very coarse; contains some gravel, very fine-medium.....	66.0	- 91.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Dennis Formation:		
Stark Member:		
Shale, black fissile.....	91.0	- 91.9
Shale, light gray.....	91.9	- 92.3
Canville Member:		
Limestone, medium gray, very finely crystal- line; contains brachiopods and "black inclusions".....	92.3	- 92.9
Galesburg Formation:		
Shale, light greenish gray.....	92.9	- 96.0
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, very finely crystal- line; contains pyrite.....	96.0	- 98.3
Shale, light greenish gray, interbedded with limestone, medium gray.....	98.3	- 99.2

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline, interbedded with shale, greenish gray; contains brachiopods.....	99.2	- 107.0
Limestone, light tannish gray, very finely crystalline; contains brachiopods, and crinoids.....	107.0	- 107.9
Limestone, light tannish gray, very finely crystalline.....	107.9	- 110.4
Hushpuckney Member:		
Shale, light greenish gray.....	110.4	- 112.5
Ladore Member:		
Shale, medium gray.....	112.5	- 115.4
Hertha Formation:		
Limestone, light tannish gray, very finely crystalline; contains chert, pyrite, pseudoolites, and abundant algal material.....	115.4	- 118.0
Shale, light greenish gray.....	118.0	- 124.5
Limestone, light tannish gray, very finely crystalline; contains pyrite.....	124.5	- 125.5
Limestone, light tannish gray, very finely crystalline.....	125.5	- 128.2
Shale, light greenish gray.....	128.2	- 128.9
Limestone, light tannish gray, very finely crystalline.....	128.9	- 129.5
Des Moines Series - Marmaton Group:		
Shale, light greenish gray.....	129.5	- 134.5
Shale, pale reddish brown.....	134.5	- 138.3
Shale, light greenish gray.....	138.3	- 142.5
Shale, reddish gray.....	142.5	- 144.1
Shale, reddish gray, interbedded with limestone, medium gray.....	144.1	- 145.9
Limestone, light greenish gray, very finely crystalline.....	145.9	- 148.7
Limestone, light gray, very finely crystalline.....	148.7	- 149.5
Shale, light gray.....	149.5	- 150.0
Shale, reddish gray.....	150.0	- 152.6
Shale, light greenish gray.....	152.6	- 155.6
Shale, light greenish gray, interbedded with limestone, light gray.....	155.6	- 156.0
Shale, reddish brown.....	156.0	- 162.1
Shale, light greenish gray, interbedded with limestone, light gray.....	162.1	- 162.4
Shale, reddish brown.....	162.4	- 165.5
Shale, light greenish gray.....	165.5	- 167.0

Test Hole 2-80

Location: Cass County, SW SW SW SW sec. 2, T. 12 N., R. 12 E.,
approximately 72 feet north of the south section line
and 20 feet east of the west section line.

Ground-level elevation: 1104.0 feet above mean sea level.

Started: May 19, 1980. Completed: May 19, 1980.

Total depth: 150.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Topsoil.....	0.0	- 3.0
Clay, yellowish brown.....	3.0	- 14.0
Silt, light reddish brown.....	14.0	- 22.0
Clay, yellowish brown, silty; contains some gravel, fine.....	22.0	- 27.0
Clay, olive; contains some gravel, fine.....	27.0	- 35.0
Clay, yellowish olive.....	35.0	- 45.5
Clay, yellowish orange; contains some gravel, very fine.....	45.5	- 47.0
Sand, very fine to very coarse; contains some gravel, fine.....	47.0	- 53.0
Clay, pale yellow with light gray mottling....	53.0	- 62.0
Clay, very light gray.....	62.0	- 64.0
Clay, very light gray, interbedded with sand, very fine to very coarse.....	64.0	- 70.0
Sand, very fine to very coarse; contains some gravel, fine.....	70.0	- 77.0
Clay, very light gray.....	77.0	- 78.2
Sand, very fine to very coarse; contains some gravel, medium.....	78.2	- 85.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Quivira Formation:		
Shale, light gray.....	85.0	- 87.0
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, very finely crystalline; contains abundant pseudo- oolites and <u>Osagia</u>	87.0	- 93.5
Limestone, light to medium gray, very finely crystalline.....	93.5	- 95.0
Limestone, light greenish gray, very finely crystalline; contains brachiopods and abundant fusulinids.....	95.0	- 99.5

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Wea Member:		
Shale, light to medium gray.....	99.5	- 100.2
Shale, black.....	100.2	- 102.3
Block Member:		
Limestone, medium to dark gray, very finely crystalline; contains pyrite.....	102.3	- 102.9
Fontana Formation:		
Shale, medium to dark gray.....	102.9	- 108.0
Dennis Formation:		
Winterset Member:		
Limestone, light tannish gray, very finely crystalline; contains pseudo-oolites.....	108.0	- 114.0
Limestone, light gray, very finely crystalline; contains pseudo-oolites and <u>Osagia</u>	114.0	- 116.2
Shale, light greenish gray.....	116.2	- 117.3
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> , brachiopods, and pseudo-oolites.....	117.3	- 118.7
Limestone, light tannish gray, very finely crystalline; contains <u>Osagia</u> , and algal material.....	118.7	- 121.8
Limestone, bluish gray, very finely crystalline; contains fusulinids, algal material and chert.....	121.8	- 124.0
Limestone, light bluish gray, very finely crystalline, interbedded with shale, light gray; contains fusulinids.....	124.0	- 125.0
Limestone, light to medium gray very finely crystalline, interbedded with shale, light gray; contains fusulinids.....	125.0	- 131.0
Shale, light to medium gray.....	131.0	- 131.2
Limestone, light to medium gray, interbedded with shale, light gray.....	131.2	- 132.0
Limestone, medium to dark gray, very finely crystalline.....	132.0	- 132.6
Shale, light gray.....	132.6	- 134.0
Limestone, medium to dark gray, very finely crystalline; contains "black inclusions"....	134.0	- 134.5
Stark Member:		
Shale, light gray.....	134.5	- 135.0
Shale, black, fissile.....	135.0	- 137.7
Canville Member:		
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	137.7	- 138.9
Galesburg Formation:		
Shale, (no sample).....	138.9	- 139.9
Swope Formation:		
Bethany Falls Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline, interbedded with shale, light greenish gray; contains algal material.....	139.9	- 149.1
Shale, light greenish gray.....	149.1	- 149.4
Limestone, light to medium gray, very finely crystalline; contains brachiopods....	149.4	- 150.0

Test Hole 3-80

Location: Cass County, NW NE NW NW sec. 12, T. 12 N., R. 12 E., approximately 22 feet south of north section line and 900 feet east of west section line.

Ground-level elevation: 1078.0 feet above mean sea level.

Started: May 20, 1980. Completed: May 20, 1980.

Total depth: 107.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 8.0
Silt, pale olive; contains some iron staining.....	8.0	- 16.5
Silt, light gray, clayey.....	16.5	- 32.0
Silt, pale reddish brown, clayey.....	32.0	- 34.0
Sand, very fine to coarse.....	34.0	- 41.2
Pennsylvanian System - Missouri Series - Kansas City Group:		
Iola Formation:		
Raytown Member:		
Limestone, light tannish gray, very finely crystalline, interbedded with shale, olive; contains crinoids.....	41.2	- 43.0
Limestone, light gray, very finely crystalline; contains brachiopods.....	43.0	- 48.0
Limestone, light to medium gray, very finely crystalline, interbedded with shale, greenish gray.....	48.0	- 49.0
Limestone, light to medium gray, very finely crystalline, interbedded with shale, medium gray.....	49.0	- 49.6

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Chanute Formation:		
Shale, light greenish gray.....	49.6	- 51.5
Shale, black.....	51.5	- 53.0
Shale, greenish gray.....	53.0	- 56.2
Drum Formation:		
Limestone, brownish gray, irregular crystalline; contains abundant <u>Osagia</u> , fusulinids, and algal material.....	56.2	- 58.5
Limestone, light to medium gray, irregular crystalline; contains fusulinids, algal material, pseudo-oolites, and "black inclusions".....	58.5	- 61.0
Limestone, brownish gray, very finely crystalline; contains abundant fusulinids, algal material, and pseudo-oolites.....	61.0	- 66.3
Limestone, dark gray, very finely crystalline, interbedded with shale, light greenish gray.....	66.3	- 68.2
Shale, light greenish gray.....	68.2	- 70.1
Limestone, light gray, very finely crystalline; contains abundant fusulinids...	70.1	- 71.2
Quivira Formation:		
Shale, light greenish gray.....	71.2	- 74.0
Sarpy Formation:		
Westerville Member:		
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , and algal material.....	74.0	- 77.0
Limestone, light brownish gray, irregular crystalline; contains abundant pseudo-oolites, fusulinids, and algal material.....	77.0	- 79.8
Limestone, light gray, very finely crystalline; contains abundant pseudo-oolites, fusulinids, and algal material.....	79.8	- 80.9
Limestone, light gray, very finely crystalline, interbedded with shale, light greenish gray.....	80.9	- 81.8
Wea Member:		
Shale, light greenish gray.....	81.8	- 83.0
Shale, black, fissile.....	83.0	- 85.0
Block Member:		
Limestone, medium to dark gray, very finely crystalline.....	85.0	- 85.3
Fontana Formation:		
Shale, light greenish gray.....	85.3	- 92.0
Dennis Formation:		
Winterset Member:		
Limestone, brownish gray, very finely crystalline; contains algal material, <u>Osagia</u> , and pyrite.....	92.0	- 94.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light brownish gray, irregular crystalline; contains abundant pseudo-oolites, algal material and pyrite.....	94.1	- 100.8
Limestone, medium to dark gray, irregular crystalline; contains pseudo-oolites.....	100.8	- 103.0
Limestone, medium to dark gray, irregular crystalline; contains pseudo-oolites, algal material and chert.....	103.0	- 107.0

Test Hole 4-80

Location: Cass County, NW NW NE sec. 2, T. 12 N., R. 12 E., approximately 12 feet south of north section line, and 2375 feet east of west section line.

Ground-level elevation: 1059.0 feet above mean sea level.

Started: May 21, 1980. Completed: May 21, 1980.

Total depth: 77.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 6.0
Clay, reddish brown.....	6.0	- 20.0
Silt, reddish brown, clayey.....	20.0	- 24.0
Silt, yellowish brown, clayey.....	24.0	- 29.0
Sand, very fine to very coarse; contains gravel, fine.....	29.0	- 30.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Sarpy Formation:		
Westerville Member:		
Shale, dark yellowish orange.....	30.0	- 32.0
Limestone, brownish gray, very finely crystalline; contains crinoids, algal material, and "black inclusions".....	32.0	- 33.5
Wea Member:		
Shale, greenish gray.....	33.5	- 35.0
Shale, black, fissile.....	35.0	- 37.1
Block Member:		
Limestone, medium gray, very finely crystal-		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
line; contains brachiopods.....	37.1	- 37.5
Fontana Formation:		
Shale, light greenish gray.....	37.5	- 44.8
Dennis Formation:		
Winterset Member:		
Limestone, light tannish gray, very finely crystalline; contains brachiopods, algal material, and pyrite.....	44.8	- 47.0
Limestone, light gray, very finely crystalline; contains fusulinids, pseudo-oolites, and algal material.....	47.0	- 49.4
Limestone, light gray, very finely crystalline, interbedded with shale, light greenish gray.....	49.4	- 53.0
Limestone, light gray, very finely crystalline.....	53.0	- 54.1
Limestone, light gray, very finely crystalline, interbedded with shale, light greenish gray.....	54.1	- 54.9
Shale, dark gray.....	54.9	- 55.2
Limestone, brownish gray, very finely crystalline; contains fusulinids and crinoids.....	55.2	- 56.0
Limestone, medium to dark gray, very finely crystalline; contains chert and pyrite.....	56.0	- 56.3
Limestone, medium gray, very finely crystalline.....	56.3	- 59.4
Limestone, light to medium gray, very finely crystalline, interbedded with shale, light gray.....	59.4	- 60.5
Limestone, light to medium gray, very finely crystalline; contains fusulinids.....	60.5	- 61.9
Limestone, light to medium gray, very finely crystalline, interbedded with shale, light greenish gray.....	61.9	- 66.0
Limestone, light to medium gray, irregular crystalline; contains fusulinids.....	66.0	- 67.3
Shale, medium gray.....	67.3	- 67.6
Limestone, medium brownish gray, very finely crystalline; contains crinoids and pyrite...	67.6	- 68.0
Shale, medium gray.....	68.0	- 68.3
Limestone, dark gray, very finely crystalline; contains pyrite and crinoids.....	68.3	- 69.0
Shale, medium gray.....	69.0	- 69.1
Limestone, medium to dark gray, very finely crystalline; contains crinoids.....	69.1	- 69.6
Shale, medium gray.....	69.6	- 70.2
Limestone, medium gray, very finely.....	70.2	- 71.0
Stark Member:		
Shale, medium gray.....	71.0	- 71.6
Shale, black, fissile.....	71.6	- 74.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Canville Member:		
Limestone, medium gray, finely crystalline....	74.0	- 74.6
Galesburg Formation:		
Shale, medium gray.....	74.6	- 76.0
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, irregular crystal- line; contains abundant pseudo-oolites and <u>Osagia</u>	76.0	- 77.0

Test Hole 5-80

Location: Cass County, NE corner sec. 2, T. 12 N., R. 12 E.,
approximately 83 feet south of north section line
and 25 feet west of east section line.

Ground-level elevation: 1042.0 feet above mean sea level.

Started: May 21, 1980. Completed: May 21, 1980.

Total depth: 212.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.5
Silt, yellowish brown.....	5.5	- 10.0
Clay, yellowish brown.....	10.0	- 25.0
Clay, yellowish brown; contains some sand, very fine to coarse.....	25.0	- 28.0
Silt, pale yellowish brown, sandy.....	28.0	- 32.5
Silt, pale reddish brown.....	32.5	- 39.0
Silt, yellowish brown.....	39.0	- 57.0
Silt, olive brown; contains sand, very fine to medium.....	57.0	- 60.8
Clay, light gray.....	60.8	- 70.0
Sand, very fine, to very coarse; contains some gravel, fine.....	70.0	- 72.0
Clay, olive, silty.....	72.0	- 81.0
Clay, medium gray, silty.....	81.0	- 90.0
Silt, light greenish gray.....	90.0	- 99.0
Limestone, boulder, medium greenish gray, very finely crystalline.....	99.0	- 102.0
Sand, very fine to very coarse; contains some gravel, fine.....	102.0	- 102.7

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Silt, brownish olive.....	102.7	- 108.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	108.0	- 112.8
Pennsylvanian System - Des Moines Series - Marmaton Group:		
Limestone, light brown, very finely crystalline; contains "black inclusions"....	112.8	- 114.0
Shale, light brown.....	114.0	- 115.0
Limestone, light gray, very finely crystal- line; contains fusulinids and "black inclusions".....	115.0	- 117.2
Shale, light greenish gray.....	117.2	- 127.1
Shale, red.....	127.1	- 142.7
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> and crinoids...	142.7	- 143.1
Shale, black.....	143.1	- 144.6
Limestone, medium gray, very finely crystalline; contains crinoids.....	144.6	- 144.8
Shale, medium gray.....	144.8	- 145.8
Shale, olive gray.....	145.8	- 148.7
Limestone, light to medium gray, very finely crystalline; contains crinoids, algal material and pyrite.....	148.7	- 152.0
Limestone, light to medium gray, very finely crystalline, interbedded with shale from 152.3-153.6.....	152.0	- 154.0
Shale, olive; contains some red mottling.....	154.0	- 158.5
Shale, medium gray; contains some red mottling.....	158.5	- 162.0
Shale, medium gray; contains red and gray mottling.....	162.0	- 164.8
Shale, medium gray.....	164.8	- 171.6
Limestone, medium to dark gray, very finely crystalline.....	171.6	- 171.8
Shale, light to medium gray.....	171.8	- 177.5
Limestone, light to medium gray, very finely crystalline, interbedded with shale, light to medium gray.....	177.5	- 179.0
Limestone, light to medium brownish gray, very finely crystalline, interbedded with shale at 182, light to medium brownish gray.	179.0	- 184.1
Shale, light to medium gray.....	184.1	- 186.2
Limestone, medium gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , and algal material.....	186.2	- 186.5
Shale, greenish gray.....	186.5	- 187.8
Limestone, light to medium gray, very finely crystalline, pseudo-oolites in upper part of limestone; contains algal material.....	187.8	- 190.5
Shale, light to medium gray.....	190.5	- 190.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light to medium gray, very finely crystalline; contains pseudo-oolites and algal material.....	190.8	- 193.7
Shale, medium to dark gray.....	193.7	- 196.0
Shale, black.....	196.0	- 196.1
Shale, medium to dark gray.....	196.1	- 199.1
Shale, olive.....	199.1	- 201.8
Shale, medium gray; contains olive mottling...	201.8	- 207.2
Limestone, light gray, irregular crystalline; contains pyrite, glauconite, and algal material.....	207.2	- 207.8
Shale, medium gray.....	207.8	- 208.7
Shale, red.....	208.7	- 212.0

Test Hole 6-80

Location: Cass County, SE NE NE SE sec. 1, T. 12 N., R. 12 E., approximately 2850 feet south of north section line, and 25 feet west of east section line.

Ground-level elevation: 1100.0 feet above mean sea level.

Started: May 30, 1980. Completed: May 30, 1980.

Total depth: 135.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, light brown.....	5.0	- 10.0
Silt, light brown, clayey.....	10.0	- 18.5
Clay, olive.....	18.5	- 22.4
Sand, very fine to very coarse; contains some gravel very fine to coarse.....	22.4	- 25.0
Clay, olive.....	25.0	- 27.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Wyandotte Formation:		
Farley Member:		
Limestone, light brown, very finely crystalline; contains, pseudo-oolites, algal material, crinoids and glauconite.....	27.0	- 32.1
Shale, light olive brown.....	32.1	- 32.7

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light brown, irregular crystalline; contains pseudo-oolites, algal material and <u>Osagia</u>	32.7	- 33.0
Island Creek Member:		
Shale, light olive brown.....	33.0	- 36.1
Argentine Member:		
Limestone, light yellowish brown, very finely crystalline; contains "black inclusions" and iron staining.....	36.1	- 37.2
Limestone, light olive brown, very finely crystalline; contains "black inclusions".....	37.2	- 39.6
Limestone, light gray, very finely crystalline.	39.6	- 41.5
Limestone, light brown, very finely crystalline.....	41.5	- 41.7
Limestone, light to medium gray, very finely crystalline; contains iron staining.....	41.7	- 43.4
Limestone, medium to dark gray, irregular crystalline.....	43.4	- 49.5
Shale, dark to medium gray.....	49.5	- 50.2
Limestone, dark to medium gray, irregular crystalline; contains crinoids, fusulinids, and "black inclusions".....	50.2	- 51.5
Shale, dark gray.....	51.5	- 52.0
Limestone, light to medium gray, irregular crystalline; contains fusulinids, and algal material.....	52.0	- 53.0
Shale, dark gray.....	53.0	- 53.2
Limestone, dark gray, very finely crystalline..	53.2	- 53.5
Shale, black.....	53.5	- 55.0
Limestone, light to medium gray, very finely crystalline; contains algal material.....	55.0	- 56.0
Quindaro Member:		
Shale, light to medium gray.....	56.0	- 58.0
Shale, black.....	58.0	- 58.1
Frisbie Member:		
Limestone, light to medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, algal material and "black inclusions".....	58.1	- 59.0
Lane Formation:		
Shale, light gray.....	59.0	- 59.3
Shale, medium gray.....	59.3	- 59.8
Shale, black.....	59.8	- 60.0
Limestone, light to medium gray, very finely crystalline; contains "black inclusions".....	60.0	- 62.5
Shale, medium gray.....	62.5	- 63.0
Limestone, medium gray very finely crystalline; contains fusulinids, pyrite, and "black inclusions".....	63.0	- 63.2

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	63.2	- 69.0
Shale, bluish gray.....	69.0	- 70.8
Iola Formation:		
Raytown Member:		
Limestone, light brownish gray, very finely crystalline; contains algal material.....	70.8	- 72.1
Limestone, light gray, very finely crystalline, with interbedded shale, medium gray...	72.1	- 74.0
Limestone, light brownish gray, very finely crystalline; contains pyrite.....	74.0	- 77.0
Limestone, medium to dark gray, very finely crystalline; contains crinoids.....	77.0	- 77.2
Limestone, light gray, very finely crystalline; contains pyrite.....	77.2	- 79.4
Shale, light gray.....	79.4	- 79.9
Limestone, medium gray, very finely crystalline; contains pyrite and algal material....	79.9	- 80.9
Chanute Formation:		
Shale, medium to dark bluish gray.....	80.9	- 82.5
Shale, black.....	82.5	- 83.0
Shale, medium to dark gray.....	83.0	- 87.0
Drum Formation:		
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	87.0	- 89.5
Limestone, medium gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> and fusulinids.....	89.5	- 89.7
Limestone, medium gray, irregular crystalline; contains pseudo-oolites and <u>Osagia</u>	89.7	- 91.0
Shale, light to medium gray.....	91.0	- 92.1
Limestone, medium brownish gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	92.1	- 94.3
Limestone, light to medium gray, very finely crystalline; contains abundant fusulinids...	94.3	- 98.0
Shale, dark gray.....	98.0	- 100.7
Limestone, medium to dark gray, irregular crystalline; contains pseudo-oolites, fusulinids, and algal material.....	100.7	- 101.2
Quivira Formation:		
Shale, light gray.....	101.2	- 102.0
Shale, medium bluish gray.....	102.0	- 102.3
Sarpy Formation:		
Westerville Member:		
Shale, light gray, limy.....	102.3	- 104.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> and algal material.....	104.0	- 107.2
Limestone, brownish gray, very finely crystalline.....	107.2	- 112.6
Wea Member:		
Shale, medium to dark gray.....	112.6	- 113.0
Shale, black.....	113.0	- 115.5
Block Member:		
Limestone, dark brownish gray, very finely crystalline.....	115.5	- 115.8
Fontana Formation:		
Shale, medium to dark bluish gray.....	115.8	- 123.0
Dennis Formation:		
Winterset Member:		
Limestone, light to medium brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids and algal material.....	123.0	- 125.4
Shale, medium bluish gray.....	125.4	- 126.0
Limestone, medium gray, irregular crystalline; contains algal material.....	126.0	- 127.3
Shale, medium to dark gray.....	127.3	- 128.0
Limestone, medium brownish gray, very finely crystalline; contains <u>Osagia</u> and algal material.....	128.0	- 132.1
Shale, dark gray.....	132.1	- 132.8
Limestone, dark brownish gray, very finely crystalline; contains crinoids and algal material.....	132.8	- 135.0

Test Hole 7-80

Location: Cass County, SW corner sec. 9, T. 12 N., R. 13 E., approximately 28 feet north of south section line and 75 feet east of west section line.

Ground-level elevation: 1015.0 feet above mean sea level.

Started: May 30, 1980. Completed: May 30, 1980.

Total depth: 212.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, olive brown, clayey.....	5.0	- 8.0
Clay, olive.....	8.0	- 11.0
Silt, olive brown, clayey.....	11.0	- 16.0
Silt, brownish red.....	16.0	- 20.0
Silt, light olive brown.....	20.0	- 22.5
Silt, dark olive gray.....	22.5	- 32.8
Silt, reddish brown.....	32.8	- 44.0
Silt, olive brown.....	44.0	- 48.0
Silt, olive brown; contains black mottling....	48.0	- 49.5
Silt, olive brown.....	49.5	- 54.0
Clay, olive brown.....	54.0	- 54.5
Clay, black.....	54.5	- 73.0
Silt, medium gray.....	73.0	- 80.0
Sand, very fine to coarse.....	80.0	- 85.0
Sand, very fine to very coarse; contains some gravel, medium.....	85.0	- 92.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Wyandotte Formation:		
Argentine Member:		
Limestone, dark gray, very finely crystalline; contains crinoids, algal material and "black inclusions".....	92.0	- 96.5
Limestone, medium to dark gray, very finely crystalline, interbedded with shale, medium to dark gray.....	96.5	- 99.2
Quindaro Member:		
Shale, black, fissile.....	99.2	- 99.8
Frisbie Member:		
Limestone, medium to dark gray, very finely crystalline; contains pseudo-oolites, and algal material.....	99.8	- 100.4
Lane Formation:		
Shale, medium to dark gray.....	100.4	- 101.9
Iola Formation:		
Raytown Member:		
Limestone, medium to dark gray, very finely crystalline; contains crinoids and pyrite...	101.9	- 102.2
Shale, medium to dark gray.....	102.2	- 102.7
Limestone, medium to dark gray, very finely crystalline; contains crinoids, fusulinids, and brachiopods.....	102.7	- 102.9
Shale, light bluish gray.....	102.9	- 109.0
Limestone, light bluish gray, very finely crystalline.....	109.0	- 110.2
Shale, light bluish gray.....	110.2	- 111.3
Limestone, light gray, very finely crystal- line.....	111.3	- 113.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light tannish gray, irregular crystalline.....	113.0	- 117.6
Shale, light gray.....	117.6	- 118.8
Limestone, light tannish gray, very finely crystalline; contains crinoids, fusulinids, <u>Osagia</u> , and pseudo-oolites.....	118.8	- 119.4
Chanute Formation:		
Shale, medium bluish gray.....	119.4	- 120.5
Shale, black.....	120.5	- 121.3
Shale, dark gray.....	121.3	- 124.5
Shale, dark bluish gray.....	124.5	- 124.6
Drum Formation:		
Limestone, light brownish gray, very finely crystalline; contains algal material.....	124.6	- 128.1
Limestone, medium to dark gray, very finely crystalline; contains algal material.....	128.1	- 129.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	129.3	- 131.5
Limestone, medium brownish gray, very finely crystalline; contains <u>Osagia</u> and algal material.....	131.5	- 132.7
Limestone, medium brownish gray, very finely crystalline; contains fusulinids.....	132.7	- 136.0
Limestone, medium gray, very finely crystalline; contains fusulinids.....	136.0	- 137.2
Shale, dark gray.....	137.2	- 140.2
Limestone, medium gray, very finely crystalline; contains pseudo-oolites and algal material.....	140.2	- 140.6
Quindaro Formation:		
Shale, light to medium gray.....	140.6	- 142.6
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, very finely crystalline; contains pseudo-oolites and algal material.....	142.6	- 150.0
Limestone, medium gray, very finely crystalline; contains pseudo-oolites and fusulinids	150.0	- 153.0
Wea Member:		
Shale, black.....	153.0	- 154.5
Block Member:		
Limestone, dark gray, very finely crystalline.	154.5	- 155.0
Fontana Formation:		
Shale, dark gray.....	155.0	- 156.0
Shale, dark bluish gray, interbedded with limestone, dark bluish gray.....	156.0	- 158.0
Dennis Formation:		
Winterset Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark bluish gray very finely crystalline, interbedded with shale, dark bluish gray.....	158.0	- 161.2
Shale, dark bluish gray.....	161.2	- 161.3
Limestone, light brownish gray, very finely crystalline; contains abundant pseudo-oolites and <u>Osagia</u>	161.3	- 168.7
Limestone, light brownish gray, very finely crystalline, interbedded with shale, light gray.....	168.7	- 170.3
Limestone, dark brownish gray, very finely crystalline; contains pseudo-oolites, algal material and pyrite.....	170.3	- 174.9
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, and fusulinids.....	174.9	- 180.9
Shale, medium gray.....	180.9	- 181.5
Limestone, light brownish gray, irregular crystalline.....	181.5	- 185.0
Shale, medium gray.....	185.0	- 185.2
Limestone, medium brownish gray, very finely crystalline; contains glauconite.....	185.2	- 186.3
Stark Member:		
Shale, medium to dark gray.....	186.3	- 187.0
Shale, black.....	187.0	- 190.0
Shale, dark gray.....	190.0	- 190.5
Canville Member:		
Limestone, dark gray, irregular crystalline; contains fusulinids and algal material.....	190.5	- 191.0
Galesburg Formation:		
Shale, bluish green gray.....	191.0	- 195.2
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, irregular crystalline; contains fusulinids, <u>Osagia</u> , pseudo-oolites, algal material, and pyrite.....	195.2	- 203.0
Shale, medium gray.....	203.0	- 203.5
Limestone, medium gray, irregular crystalline; contains fusulinids, <u>Osagia</u> , pseudo-oolites, algal material and pyrite.....	203.5	- 210.4
Hushpuckney Member:		
Shale, dark gray; contains black mottling.....	210.4	- 212.0

Test Hole 8-80

Location: Cass County, SW SE SE SW sec. 32, T. 13 N., R. 13 E.,
approximately 175 feet north of south section line,
and 550 feet west of half section line.

Ground-level elevation: 1191.0 feet above mean sea level.

Started: June 10, 1980. Completed: June 10, 1980.

Total depth: 240.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, yellowish brown.....	0.0	- 12.0
Silt, brown.....	12.0	- 16.0
Silt, olive brown.....	16.0	- 22.0
Silt, brown, clayey.....	22.0	- 41.0
Silt, light brown.....	41.0	- 69.0
Silt, light to medium brown, clayey.....	69.0	- 97.0
Silt, medium brown, clayey.....	97.0	- 104.0
Clay, olive.....	104.0	- 106.5
Clay, olive; contains sand, very fine to fine.	106.5	- 109.0
Sand, very fine to very coarse; contains some gravel, coarse.....	109.0	- 120.0
Clay, olive; contains sand, very fine to medium.....	120.0	- 123.0
Clay, dark gray.....	123.0	- 133.0
Pennsylvanian System - Missouri Series - Lansing Group:		
Stanton Formation:		
South Bend Member:		
Limestone, light brownish gray, irregular crystalline; contains abundant fusulinids, <u>Osagia</u> , crinoids and pseudo-oolites.....	133.0	- 134.5
Limestone, light brownish gray, irregular crystalline, interbedded with shale, light gray; contains abundant fusulinids.....	134.5	- 135.2
Limestone, light gray, very finely crystal- line; contains abundant fusulinids, <u>Osagia</u> , and pseudo-oolites.....	135.2	- 138.1
Shale, bluish gray.....	138.1	- 138.6
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, <u>Osagia</u> , pseudo-oolites and algal material.....	138.6	- 139.0
Rock Lake Member:		
Shale, dark gray.....	139.0	- 139.2
Shale, medium gray.....	139.2	- 140.0
Shale, olive.....	140.0	- 144.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Stoner Member:		
Limestone, olive gray, very finely crystalline, interbedded with shale, olive gray....	144.0	- 145.5
Limestone, light grayish brown, very finely crystalline; contains fusulinids.....	145.5	- 146.8
Shale, light gray.....	146.8	- 147.3
Limestone, light gray, very finely crystalline.....	147.3	- 150.0
Limestone, very light gray, irregular crystalline; contains algal material.....	150.0	- 155.0
Shale, medium gray.....	155.0	- 157.5
Limestone, medium brownish gray, very finely crystalline; contains crinoids and algal material.....	157.5	- 158.3
Limestone, dark brownish gray, very finely crystalline; contains crinoids and algal material.....	158.3	- 159.1
Eudora Member:		
Shale, medium gray.....	159.1	- 160.2
Shale, black.....	160.2	- 161.0
Shale, medium gray; contains fusulinids.....	161.0	- 161.5
Captain Creek Member:		
Limestone, dark gray, very finely crystalline; contains fusulinids.....	161.5	- 162.2
Vilas Formation:		
Shale, dark gray.....	162.2	- 164.0
Limestone, dark brownish gray, very finely crystalline.....	164.0	- 164.5
Shale, dark gray.....	164.5	- 165.5
Limestone, dark gray, very finely crystalline.....	165.5	- 165.6
Shale, dark gray.....	165.6	- 166.0
Shale, medium gray.....	166.0	- 166.5
Plattsburg Formation:		
Limestone, medium gray, irregular crystalline; contains <u>Osagia</u> and pseudo-oolites.....	166.5	- 169.0
Limestone, light gray, irregular crystalline; contains <u>Osagia</u> , pseudo-oolites, algal material and pyrite.....	169.0	- 172.1
Shale, medium gray.....	172.1	- 173.0
Limestone, light gray, irregular crystalline; contains crinoids, <u>Osagia</u> , algal material and glauconite.....	173.0	- 175.0
Limestone, brownish gray, very finely crystalline.....	175.0	- 180.1
Kansas City Group:		
Bonner Spring Formation:		
Shale, dark gray.....	180.1	- 182.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark gray, very finely crystalline; contains algal material and "black inclusions".....	182.1	- 182.4
Shale, dark gray.....	182.4	- 184.0
Limestone, greenish gray, very finely crystalline.....	184.0	- 187.0
Wyandotte Formation:		
Farley Member:		
Limestone, light brownish gray, very finely crystalline, interbedded with shale, greenish gray; contains pyrite.....	187.0	- 190.0
Limestone, light gray, very finely crystalline; contains glauconite and pyrite.	190.0	- 193.8
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	193.8	- 195.0
Island Creek Member:		
Shale, medium gray.....	195.0	- 198.6
Argentine Member:		
Limestone, light gray, very finely crystalline; contains pyrite.....	198.6	- 200.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray; contains pyrite.....	200.0	- 204.0
Limestone, medium gray, very finely crystalline; contains <u>Osagia</u> and algal material....	204.0	- 205.0
Limestone, medium brownish gray, very finely crystalline.....	205.0	- 209.0
Limestone, medium to dark brownish gray, very finely crystalline; contains crinoids.....	209.0	- 212.0
Shale, medium gray.....	212.0	- 214.2
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	214.2	- 216.0
Shale, medium gray.....	216.0	- 216.5
Limestone, light gray, very finely crystalline, interbedded with shale, dark gray.....	216.5	- 219.9
Quindaro Member:		
Shale, medium gray.....	219.9	- 220.5
Shale, black.....	220.5	- 222.5
Shale, dark gray.....	222.5	- 223.0
Frisbie Member:		
Limestone, dark gray, irregular crystalline...	223.0	- 223.5
Lane Formation:		
Shale, medium gray.....	223.5	- 233.0
Shale, medium gray, interbedded with limestone, light brownish gray.....	233.0	- 233.8
Shale, medium greenish gray.....	233.8	- 235.4
Iola Formation:		
Raytown Member:		
Limestone, light brownish gray, very finely crystalline; contains algal material.....	235.4	- 240.0

Test Hole 9-80

Location: Cass County, NE SE NE NW sec. 4, T. 12 N., R. 13 E.,
approximately 800 feet south of north section line,
and 20 feet west of half section line.

Ground-level elevation: 1078.5 feet above mean sea level.

Started: June 3, 1980. Completed: June 3, 1980.

Total depth: 205.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 4.0
Silt, medium brown.....	4.0	- 8.0
Silt, reddish brown.....	8.0	- 22.0
Silt, reddish brown, clayey.....	22.0	- 60.5
Silt, reddish brown; contains sand, very fine.	60.5	- 74.5
Silt, reddish brown, clayey.....	74.5	- 87.0
Silt, yellowish brown, clayey; contains sand, very fine to coarse.....	87.0	- 95.0
Silt, olive, clayey; contains sand, very fine to fine.....	95.0	- 99.5
Clay, olive; contains very fine sand to fine gravel.....	99.5	- 101.4
Pennsylvanian System - Virgil Series - Douglas Group:		
Plattford Formation:		
Shale, olive.....	101.4	- 105.0
Missouri Series - Lansing Group:		
Stanton Formation:		
South Bend Member:		
Limestone, tan, irregular crystalline; contains, pseudo-oolites and <u>Osagia</u>	105.0	- 106.1
Limestone, medium yellowish brown, irregular crystalline; contains fusulinids, <u>Osagia</u> , and "black inclusions".....	106.1	- 106.8
Shale, olive.....	106.8	- 108.7
Shale, medium gray.....	108.7	- 109.0
Limestone, tannish gray, irregular crystal- line; contains pseudo-oolites, fusulinids, algal material and <u>Osagia</u>	109.0	- 114.1
Shale, bluish gray.....	114.1	- 114.3
Limestone, medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, algal material, and <u>Osagia</u>	114.3	- 115.2
Rock Lake Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium to dark bluish gray.....	115.2	- 120.4
Stoner Member:		
Limestone, medium gray, very finely crystalline.....	120.4	- 122.3
Shale, bluish gray.....	122.3	- 122.7
Limestone, medium gray, very finely crystalline; contains algal material and <u>Osagia</u>	122.7	- 123.0
Limestone, light tan, very finely crystalline; contains pyrite.....	123.0	- 127.1
Shale, medium gray.....	127.1	- 127.2
Limestone, light tannish gray, very finely crystalline.....	127.2	- 128.0
Shale, medium gray.....	128.0	- 128.1
Limestone, light tannish gray, very finely crystalline.....	128.1	- 128.7
Shale, medium gray.....	128.7	- 128.8
Limestone, very light gray, very finely crystalline.....	128.8	- 130.1
Shale, medium gray.....	130.1	- 130.2
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, algal material and pyrite.....	130.2	- 131.0
Limestone, medium to dark gray, very finely crystalline, interbedded with shale, medium to dark gray.....	131.0	- 131.4
Shale, medium gray.....	131.4	- 133.8
Limestone, dark brownish gray, very finely crystalline; contains crinoids.....	133.8	- 135.0
Limestone, dark gray, very finely crystalline, interbedded with shale from 135-135.1, black.....	135.0	- 135.4
Shale, medium to dark gray.....	135.4	- 136.8
Shale, black.....	136.8	- 137.0
Limestone, medium to dark gray, very finely crystalline; contains crinoids, and algal material.....	137.0	- 137.4
Eudora Member:		
Shale, medium to dark gray.....	137.4	- 138.3
Limestone, dark gray, very finely crystalline; contains algal material.....	138.3	- 138.5
Shale, black.....	138.5	- 140.2
Captain Creek Member:		
Limestone, medium brownish gray, irregular crystalline; contains crinoids.....	140.2	- 141.0
Vilas Formation:		
Shale, dark gray.....	141.0	- 142.3
Shale, bluish gray.....	142.3	- 145.0
Plattsburg Formation:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, algal material and bryozoan.....	145.0	- 148.3
Limestone, bluish gray, irregular crystalline; contains pseudo-oolites, fusulinids, and glauconite.....	148.3	- 149.0
Shale, light to medium gray.....	149.0	- 150.9
Limestone, brownish gray, very finely crystalline; contains crinoids, <u>Osagia</u> , and glauconite.....	150.9	- 151.3
Shale, light gray.....	151.3	- 152.2
Limestone, brownish gray, very finely crystalline; contains crinoids, and bryozoan.....	152.2	- 155.1
Limestone, dark gray, very finely crystalline; contains fusulinids.....	155.1	- 155.9
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	155.9	- 157.6
Kansas City Group:		
Bonner Springs Formation:		
Shale, dark gray to black.....	157.6	- 159.1
Shale, black.....	159.1	- 162.0
Shale, red.....	162.0	- 163.0
Shale, dark gray.....	163.0	- 165.8
Wyandotte Formation:		
Farley Member:		
Limestone, brownish gray, very finely crystalline.....	165.8	- 170.3
Limestone, medium to dark gray, very finely crystalline, interbedded with shale, medium gray.....	170.3	- 172.2
Island Creek Member:		
Shale, medium gray.....	172.2	- 175.3
Argentine Member:		
Limestone, brownish gray, very finely crystalline; contains pyrite.....	175.3	- 180.0
Shale, medium gray.....	180.0	- 181.5
Limestone, brownish gray, very finely crystalline.....	181.5	- 189.6
Shale, light to medium gray.....	189.6	- 191.5
Limestone, medium to dark gray, very finely crystalline; contains fusulinids.....	191.5	- 192.7
Shale, dark gray.....	192.7	- 193.0
Limestone, dark brownish gray, very finely crystalline; contains crinoids.....	193.0	- 195.8
Quindaro Member:		
Shale, medium gray.....	195.8	- 197.3
Shale, black.....	197.3	- 197.4
Limestone, dark brownish gray, very finely		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
crystalline, interbedded with shale, medium gray.....	197.4	- 198.3
Shale, black, fissile.....	198.3	- 199.4
Shale, medium gray.....	199.4	- 200.0
Frisbie Member:		
Limestone, dark brownish gray, very finely crystalline; contains crinoids.....	200.0	- 200.5
Shale, medium gray.....	200.5	- 201.3
Limestone, dark brownish gray, very finely crystalline; contains "black inclusions"....	201.3	- 201.9
Lane Formation:		
Shale, medium gray.....	201.9	- 205.0

Test Hole 10-80

Location: Cass County, SW SW SE SW sec. 10, T. 12 N., R. 13 E., approximately 23 feet north of south section line, and 1450 feet east of west section line.

Ground-level elevation: 1068.0 feet above mean sea level.

Started: June 4, 1980. Completed: June 4, 1980.

Total depth: 180.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 2.0
Silt, olive, clayey; contains some sand, medium to coarse.....	2.0	- 7.0
Silt, yellowish brown, clayey; contains some sand in upper part of sample, medium to coarse.....	7.0	- 14.0
Silt, reddish olive, clayey.....	14.0	- 21.0
Silt, reddish brown; contains sand, medium....	21.0	- 22.0
Sand, very fine to coarse.....	22.0	- 23.0
Silt, olive; contains sand very fine to coarse.....	23.0	- 24.0
Sand, very fine to coarse.....	24.0	- 24.9
Clay, yellowish brown.....	24.9	- 30.0
Clay, olive yellowish brown.....	30.0	- 33.0
Clay, olive brown.....	33.0	- 35.2
Clay, yellowish brown, silty.....	35.2	- 37.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Clay, olive; contains some sand, very fine....	37.0	- 41.5
Clay, olive.....	41.5	- 48.0
Clay, dark gray.....	48.0	- 51.5
Clay, dark bluish gray.....	51.5	- 57.0
Clay, dark bluish gray, silty; contains some medium sand.....	57.0	- 79.0
Pennsylvanian System - Virgil Series - Douglas Group:		
Cass Formation:		
Haskell Member:		
Limestone, dark gray, very finely crystalline; contains pseudo-oolites and algal material..	79.0	- 79.9
Shale, dark bluish gray.....	79.9	- 80.6
Limestone, dark gray, very finely crystalline; contains algal material.....	80.6	- 82.1
Shale, dark gray.....	82.1	- 82.4
Limestone, medium gray, very finely crystalline; contains crinoids, fusulinids and "black inclusions".....	82.4	- 84.0
Little Pawnee Member:		
Shale, medium to dark gray.....	84.0	- 84.5
Shale, black.....	84.5	- 85.6
Shoemaker Member:		
Limestone, medium to dark gray, finely crystalline; contains crinoids, algal material and pyrite.....	85.6	- 86.7
Plattford Formation:		
Unnamed Member:		
Shale, greenish gray.....	86.7	- 90.0
Shale, bluish green gray.....	90.0	- 91.7
Shale, bluish green gray, interbedded with limestone, bluish green gray.....	91.7	- 95.2
Nehawka Member:		
Limestone, brownish gray, very finely crystalline, interbedded with shale, bluish green gray.....	95.2	- 98.0
Limestone, medium gray, very finely crystalline; contains brachiopods and algal material.....	98.0	- 99.1
Shale, bluish gray.....	99.1	- 99.4
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray; contains fusulinids.....	99.4	- 101.8
Unnamed Member:		
Shale, greenish gray.....	101.8	- 104.5
Missouri Series - Lansing Group:		
Stanton Formation:		
South Bend Member:		
Limestone, brownish gray, very finely		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, and "black inclusions"...	104.5	- 107.2
Shale, medium to dark gray.....	107.2	- 110.3
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, and glauconite.....	110.3	- 115.1
Rock Lake Member:		
Shale, dark gray.....	115.1	- 115.8
Shale, bluish green gray.....	115.8	- 116.7
Stoner Member:		
Limestone, light gray, very finely crystal- line, interbedded with shale, bluish green gray.....	116.7	- 119.1
Limestone, light to medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, and pyrite.....	119.1	- 120.0
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and pyrite.....	120.0	- 121.0
Limestone, light brownish gray, irregular crystalline, interbedded with shale, bluish green gray.....	121.0	- 121.2
Limestone, light tannish gray, very finely crystalline.....	121.2	- 123.0
Limestone, light tannish gray, very finely crystalline; contains chert.....	123.0	- 125.0
Shale, medium to dark brownish gray.....	125.0	- 125.2
Limestone, light tannish gray, irregular crystalline; contains chert, brachiopods, iron staining, and algal material.....	125.2	- 126.2
Limestone, light tannish gray, very finely crystalline, interbedded with shale, light tannish gray.....	126.2	- 126.8
Limestone, light tannish gray, very finely crystalline; contains chert.....	126.8	- 130.5
Limestone, medium to light brownish gray, very finely crystalline, interbedded with shale, medium gray.....	130.5	- 132.1
Limestone, dark brownish gray, very finely crystalline; contains algal material, crinoids, and pyrite.....	132.1	- 133.9
Shale, medium gray.....	133.9	- 135.5
Shale, black.....	135.5	- 136.2
Limestone, medium gray, very finely crystal- line; contains abundant pyrite.....	136.2	- 136.7
Eudora Member:		
Shale, medium gray.....	136.7	- 137.0
Shale, black.....	137.0	- 137.4
Captain Creek Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark gray, very finely crystalline; contains brachiopods, crinoids, and pyrite.....	137.4	- 137.9
Shale, dark gray.....	137.9	- 138.4
Limestone, dark gray, very finely crystalline; contains crinoids, and pyrite.....	138.4	- 140.0
Vilas Formation:		
Shale, dark gray.....	140.0	- 141.8
Shale, greenish gray.....	141.8	- 142.0
Plattsburg Formation:		
Limestone, brownish gray, very finely crystalline, interbedded with shale, bluish green gray.....	142.0	- 148.1
Limestone, light gray, very finely crystalline; contains crinoids, fusulinids, and pyrite.....	148.1	- 150.4
Limestone, light tannish gray, very finely crystalline; contains brachiopods.....	150.4	- 154.1
Limestone, dark brownish gray, very finely crystalline; contains brachiopods.....	154.1	- 156.0
Shale, medium to dark gray.....	156.0	- 156.2
Limestone, dark brownish gray, very finely crystalline; contains brachiopods.....	156.2	- 156.5
Kansas City Group:		
Bonner Springs Formation:		
Shale, dark gray.....	156.5	- 160.6
Shale, medium gray.....	160.6	- 165.8
Wyandotte Formation:		
Farley Member:		
Limestone, light gray, very finely crystalline; contains algal material.....	165.8	- 167.2
Limestone, brownish gray, very finely crystalline, interbedded with shale, greenish gray.....	167.2	- 168.9
Limestone, brownish gray, very finely crystalline; contains algal material.....	168.9	- 173.0
Island Creek Member:		
Shale, medium gray.....	173.0	- 174.5
Argentine Member:		
Limestone, light gray, very finely crystalline; contains fusulinids and pyrite.....	174.5	- 180.0

Test Hole 11-80

Location: Cass County, SW SW SW SE sec. 3, T. 12 N., R. 13 E.,
approximately 191 feet north of south section line,
and 20 feet east of half section line.

Ground-level elevation: 1031.0 feet above mean sea level.

Started: June 4, 1980. Completed: June 4, 1980.

Total depth: 152.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 4.0
Silt, reddish brown, clayey.....	4.0	- 21.0
Silt, olive brown.....	21.0	- 26.0
Silt, reddish brown.....	26.0	- 28.0
Pennsylvanian System - Virgil Series - Douglas Group:		
Lawrence Formation:		
Shale, red.....	28.0	- 36.5
Shale, olive.....	36.5	- 40.4
Shale, olive to light blue.....	40.4	- 44.0
Shale, bluish gray.....	44.0	- 58.3
Shale, olive brownish gray.....	58.3	- 62.5
Shale, medium gray.....	62.5	- 67.1
Cass Formation:		
Haskell Member:		
Limestone, dark gray, very finely crystalline; contains algal material.....	67.1	- 68.1
Shale, dark gray.....	68.1	- 69.0
Limestone, dark gray, very finely crystalline; contains abundant brachiopods, crinoids and fusulinids.....	69.0	- 70.6
Shale, black.....	70.6	- 70.7
Limestone, dark gray, very finely crystalline; contains abundant crinoids, brachiopods, glauconite and pyrite.....	70.7	- 72.2
Little Pawnee Member:		
Shale, dark gray.....	72.2	- 73.5
Shale, black.....	73.5	- 74.0
Shoemaker Member:		
Limestone, dark gray, very finely crystalline; contains abundant crinoids, pyrite and glauconite.....	74.0	- 75.2
Plattford Formation:		
Unnamed Member:		
Shale, medium gray.....	75.2	- 78.4

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, greenish gray.....	78.4	- 82.0
Shale, greenish gray, interbedded with limestone, greenish gray.....	82.0	- 83.5
Shale, medium gray.....	83.5	- 84.9
Nehawka Member:		
Limestone, light brownish gray, very finely crystalline.....	84.9	- 86.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray; contains brachiopods.....	86.0	- 90.5
Limestone, medium gray, very finely crystalline.....	90.5	- 91.5
Unnamed Member:		
Shale, medium gray.....	91.5	- 94.0
Missouri Series - Lansing Group:		
Stanton Formation:		
South Bend Member:		
Limestone, tannish gray, very finely crystalline; contains <u>Osagia</u> , fusulinids, and algal material.....	94.0	- 97.0
Shale, dark gray, interbedded with limestone, dark gray; contains fusulinids.....	97.0	- 100.0
Limestone, brownish gray, very finely crystalline; contains abundant pseudoololites, fusulinids, crinoids, pyrite, and glauconite.....	100.0	- 104.0
Rock Lake Member:		
Shale, medium gray, interbedded with limestone, medium gray.....	104.0	- 109.7
Stoner Member:		
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	109.7	- 112.4
Limestone, light gray, irregular crystalline; contains brachiopods, algal material, coral, and pyrite.....	112.4	- 119.8
Shale, medium gray.....	119.8	- 124.0
Limestone, medium gray, very finely crystalline; contains crinoids and fusulinids.....	124.0	- 125.0
Shale, medium to dark gray.....	125.0	- 125.1
Limestone, medium gray, very finely crystalline; contains crinoids and pyrite.....	125.1	- 125.2
Shale, medium gray.....	125.2	- 127.0
Shale, black.....	127.0	- 127.2
Limestone, brownish gray, very finely crystalline.....	127.2	- 127.5
Shale, dark gray.....	127.5	- 128.0
Shale, black.....	128.0	- 128.6
Limestone, dark gray, very finely crystalline; contains crinoids and brachiopods.....	128.6	- 129.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Eudora Member:		
Shale, black.....	129.0	- 130.0
Captain Creek Member:		
Limestone, dark gray, very finely crystal- line; contains crinoids.....	130.0	- 131.2
Vilas Formation:		
Shale, dark gray.....	131.2	- 132.5
Shale, medium gray.....	132.5	- 135.4
Plattsburg Formation:		
Limestone, medium gray, very finely crystal- line; contains brachiopods.....	135.4	- 138.9
Shale, medium gray, interbedded with lime- stone, medium gray.....	138.9	- 140.0
Limestone, brownish gray, very finely crystalline; contains fusulinids.....	140.0	- 142.5
Shale, medium gray.....	142.5	- 142.9
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> and glauconite.....	142.9	- 145.1
Limestone, dark brownish gray, very finely crystalline; contains crinoids, brachiopods, and "black inclusions".....	145.1	- 148.2
Kansas City Group:		
Bonner Springs Formation:		
Shale, dark gray.....	148.2	- 150.2
Shale, medium gray.....	150.2	- 152.0

Test Hole 12-80

Location: Cass County, NW corner NE sec. 3, T. 12 N., R. 13 E.,
approximately 120 feet south of north section line,
and 16 feet east of half section line.

Ground-level elevation: 973.0 feet above mean sea level.

Started: June 5, 1980. Completed: June 5, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 4.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Silt, dark brown.....	4.0 -	11.0
Silt, dark olive brown.....	11.0 -	12.0
Silt, olive.....	12.0 -	21.2
Silt, olive brown; contains some sand, medium to coarse.....	21.2 -	27.0
Sand, very fine to medium.....	27.0 -	41.8
Pennsylvanian System - Missouri Series - Lansing Group:		
Stanton Formation:		
Stoner Member:		
Limestone, light tannish gray, very finely crystalline.....	41.8 -	43.7
Limestone, light tannish gray, very finely crystalline, interbedded with shale, greenish gray.....	43.7 -	43.9
Limestone, light gray, very finely crystalline.....	43.9 -	49.2
Shale, greenish gray; contains fusulinids.....	49.2 -	52.0
Limestone, dark greenish gray, finely crystalline; contains crinoids and fusulinids.....	52.0 -	52.9
Shale, dark greenish gray.....	52.9 -	55.0
Shale, black.....	55.0 -	55.1
Limestone, dark greenish gray, very finely crystalline; contains crinoids and fusulinids.....	55.1 -	55.3
Eudora Member:		
Shale, black.....	55.3 -	56.2
Captain Creek Member:		
Limestone, dark greenish gray, very finely crystalline; contains brachiopods, bryozoan, and "black inclusions".....	56.2 -	56.9
Shale, medium to dark gray.....	56.9 -	57.4
Limestone, dark gray, very finely crystalline; contains bryozoan, crinoids and "black inclusions".....	57.4 -	58.1
Vilas Formation:		
Shale, dark gray.....	58.1 -	60.3
Shale, greenish gray.....	60.3 -	62.8
Plattsburg Formation:		
Limestone, medium brownish gray, very finely crystalline, interbedded with shale, bluish gray.....	62.8 -	65.9
Limestone, medium gray, very finely crystalline; contains fusulinids and <u>Osagia</u>	65.9 -	66.6
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray; contains fusulinids, crinoids, and <u>Osagia</u> ...	66.6 -	70.1
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	70.1 -	71.4

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark brownish gray, very finely crystalline; contains brachiopods.....	71.4	- 72.5
Limestone, dark brownish gray, very finely crystalline, interbedded with shale, black, fissile.....	72.5	- 72.9
Limestone, dark brownish gray, irregular crystalline; contains crinoids.....	72.9	- 75.3
Shale, medium gray.....	75.3	- 76.0
Shale, medium to dark gray.....	76.0	- 77.0
Limestone, dark gray, very finely crystalline; contains crinoids.....	77.0	- 77.2
Kansas City Group:		
Bonner Springs Formation:		
Shale, medium gray.....	77.2	- 81.4
Shale, red.....	81.4	- 84.5
Shale, greenish gray.....	84.5	- 85.5
Wyandotte Formation:		
Farley Member:		
Limestone, medium gray, very finely crystalline.....	85.5	- 86.0
Shale, medium gray.....	86.0	- 88.2
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> , pseudo-oolites, and algal material.....	88.2	- 91.0
Island Creek Member:		
Shale, medium gray.....	91.0	- 94.0
Argentine Member:		
Limestone, medium gray, very finely crystalline.....	94.0	- 96.1
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	96.1	- 98.2
Shale, medium gray.....	98.2	- 99.0
Limestone, medium gray, very finely crystalline, interbedded with shale, greenish gray.	99.0	- 100.1
Limestone, light brownish gray, irregular crystalline; contains bryozoan.....	100.1	- 105.0
Limestone, light brownish gray, very finely crystalline; contains brachiopods and crinoids.....	105.0	- 109.2
Shale, medium gray.....	109.2	- 109.6
Limestone, medium gray, very finely crystalline; contains crinoids.....	109.6	- 115.0
Shale, medium gray.....	115.0	- 115.7
Limestone, medium gray, very finely crystalline; contains crinoids and "black inclusions".....	115.7	- 117.2

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quindaro Member:		
Shale, medium gray.....	117.2	- 118.0
Shale, black.....	118.0	- 119.0
Frisbie Member:		
Limestone, medium gray, very finely crystalline; contains fusulinids and crinoids.....	119.0	- 121.1
Shale, medium gray.....	121.1	- 121.6
Limestone, medium gray, very finely crystalline; contains fusulinids and crinoids.....	121.6	- 121.8
Limestone, light gray, very finely crystalline, interbedded with shale, light gray.....	121.8	- 122.0
Lane Formation:		
Shale, medium gray.....	122.0	- 127.5
Iola Formation:		
Raytown Member:		
Limestone, light gray, very finely crystalline, interbedded with shale, greenish gray.....	127.5	- 128.0
Limestone, light gray, very finely crystalline; contains brachiopods.....	128.0	- 129.0
Limestone, light gray, very finely crystalline, interbedded with shale, light gray; contains brachiopods and algal material.....	129.0	- 131.0
Limestone, light gray, very finely crystalline; contains iron staining.....	131.0	- 136.9
Shale, medium gray.....	136.9	- 137.0

Test Hole 13-80

Location: Cass County, NE NE NW SW sec. 7, T. 12 N., R. 13 E.,
approximately 24 feet south of half section line,
and 900 feet east of west section line.

Ground-level elevation: 1108.0 feet above mean sea level.

Started: June 5, 1980. Completed: June 5, 1980.

Total depth: 152.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, olive, clayey.....	5.0	- 6.0
Silt, olive yellowish brown.....	6.0	- 10.0
Silt, olive yellowish brown, clayey.....	10.0	- 17.5
Silt, reddish brown.....	17.5	- 71.0
Silt, reddish brown; contains some sand, medium.....	71.0	- 75.7
Silt, olive.....	75.7	- 83.5
Silt, olive yellow.....	83.5	- 89.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Bonner Springs Formation:		
Limestone, yellowish brown, very finely crystalline; contains crinoids and "black inclusions".....	89.0	- 90.1
Shale, olive.....	90.1	- 92.0
Shale, olive, interbedded with limestone, olive.....	92.0	- 95.0
Wyandotte Formation:		
Farley Member:		
Limestone, light orange gray, very finely crystalline; contains "black inclusions"....	95.0	- 99.8
Limestone, medium orange gray, very finely crystalline; contains <u>Osagia</u> , pseudo- oolites, and algal material.....	99.8	- 103.4
Shale, light orange gray.....	103.4	- 104.0
Limestone, light orange gray, very finely crystalline; contains <u>Osagia</u> , pseudo- oolites, algal material and crinoids.....	104.0	- 104.9
Island Creek Member:		
Shale, medium brown.....	104.9	- 106.2
Argentine Member:		
Limestone, light gray, very finely crystalline; contains crinoids.....	106.2	- 113.5
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	113.5	- 114.5
Limestone, medium gray, very finely crystalline; contains fusulinids.....	114.5	- 115.5
Limestone, dark gray, irregular crystalline; contains chert, algal material and pyrite...	115.5	- 116.0
Limestone, medium gray, very finely crystalline; contains algal material.....	116.0	- 121.0
Limestone, medium gray, very finely crystalline; contains crinoids.....	121.0	- 122.4
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	122.4	- 123.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark gray, very finely crystalline; contains crinoids.....	123.0	- 127.0
Shale, medium gray.....	127.0	- 128.0
Shale, black.....	128.0	- 129.6
Limestone, dark gray, very finely crystalline; contains crinoids and "black inclusions"....	129.6	- 130.0
Quindaro Member:		
Shale, medium gray.....	130.0	- 131.0
Shale, black.....	131.0	- 132.0
Frisbie Member:		
Limestone, medium gray very finely crystal- line; contains <u>Osagia</u> , pseudo-oolites, and "black inclusions".....	132.0	- 134.7
Shale, medium gray.....	134.7	- 135.2
Limestone, medium gray, very finely crystal- line; contains crinoids, fusulinids, and "black inclusions".....	135.2	- 135.9
Lane Formation:		
Shale, medium gray.....	135.9	- 142.3
Iola Formation:		
Raytown Member:		
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	142.3	- 145.3
Limestone, medium gray, very finely crystalline.....	145.3	- 147.0
Limestone, light gray, very finely crystalline; contains pyrite and glauconite.....	147.0	- 149.9
Limestone, light brownish gray, very finely crystalline.....	149.9	- 151.5
Shale, medium gray.....	151.5	- 152.0

Test Hole 14-80

Location: Cass County, NW NE NW NE sec. 21, T. 12 N., R. 13 E.,
approximately 18 feet south of north section line,
and 1950 feet west of east section line.

Ground-level elevation: 1040.0 feet above mean sea level.

Started: June 6, 1980. Completed: June 6, 1980.

Total depth: 242.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, olive.....	5.0	- 10.0
Silt, olive brown, clayey.....	10.0	- 13.5
Silt, reddish brown, clayey.....	13.5	- 23.0
Silt, brownish red, clayey.....	23.0	- 24.0
Silt, reddish brown, clayey.....	24.0	- 67.0
Silt, medium brown, clayey.....	67.0	- 70.0
Silt, olive, clayey.....	70.0	- 82.0
Clay, olive.....	82.0	- 107.5
Clay, olive gray.....	107.5	- 112.0
Clay, dark bluish gray.....	112.0	- 121.0
Clay, dark gray.....	121.0	- 122.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	122.0	- 132.0
Gravel, fine to coarse.....	132.0	- 135.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Wyandotte Formation:		
Argentine Member:		
Limestone, light yellowish gray, very finely crystalline.....	135.0	- 136.0
Shale, dark gray, fissile.....	136.0	- 136.2
Limestone, dark gray, very finely crystal- line.....	136.2	- 138.0
Limestone, medium to dark gray, very finely crystalline; contains crinoids and "black inclusions".....	138.0	- 140.3
Shale, light bluish gray.....	140.3	- 141.2
Quindaro Member:		
Shale, light bluish gray, interbedded with limestone, light bluish gray.....	141.2	- 143.5
Shale, black, fissile.....	143.5	- 145.2
Frisbie Member:		
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, crinoids, and algal material.....	145.2	- 145.4
Lane Formation:		
Shale, medium gray.....	145.4	- 149.0
Iola Formation:		
Raytown Member:		
Limestone, medium gray, very finely crystal- line; contains brachiopods, and fusulinids..	149.0	- 149.2
Shale, medium to dark gray.....	149.2	- 153.1
Limestone, brownish gray, very finely crystalline, interbedded with shale, bluish gray.....	153.1	- 155.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline.....	155.8	- 156.5
Shale, medium gray.....	156.5	- 156.9
Limestone, light brownish gray, very finely crystalline; contains fusulinids.....	156.9	- 159.2
Limestone, light brownish gray, very finely crystalline.....	159.2	- 161.0
Shale, medium gray.....	161.0	- 161.3
Limestone, medium gray, very finely crystalline; contains crinoids.....	161.3	- 163.0
Chanute Formation:		
Shale, medium gray.....	163.0	- 164.0
Shale, black.....	164.0	- 164.5
Shale, medium gray.....	164.5	- 167.4
Drum Formation:		
Limestone, light gray, very finely crystalline; contains abundant pseudo-oolites, abundant <u>Osagia</u> , fusulinids, and crinoids..	167.4	- 169.1
Limestone, brownish gray, very finely crystalline; contains abundant pseudo-oolites, abundant <u>Osagia</u> , fusulinids, and crinoids.....	169.1	- 170.0
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , algal material and crinoids.....	170.0	- 172.2
Limestone, medium to dark brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids and algal material.....	172.2	- 174.8
Limestone, light gray, irregular crystalline; contains pseudo-oolites, algal material, and pyrite.....	174.8	- 177.1
Limestone, light gray, very finely crystalline, interbedded with shale, light gray.....	177.1	- 177.5
Shale, medium gray.....	177.5	- 179.8
Limestone, light to medium brownish gray, very finely crystalline; contains fusulinids, and <u>Osagia</u>	179.8	- 180.5
Quivira Formation:		
Shale, medium gray.....	180.5	- 181.6
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, very finely crystalline; contains fusulinids, pseudo-oolites and algal material.....	181.6	- 183.0
Shale, medium gray.....	183.0	- 183.9
Limestone, light gray, very finely crystalline; contains pseudo-oolites.....	183.9	- 185.0
Shale, light gray to white.....	185.0	- 187.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, irregular crystalline; contains pseudo-oolites, abundant <u>Osagia</u> , crinoids, fusulinids, and "black inclusions".....	187.0	- 191.0
Limestone, medium gray, very finely crystalline; contains fusulinids, crinoids, and pseudo-oolites.....	191.0	- 196.0
Wea Member:		
Shale, medium gray.....	196.0	- 196.8
Shale, black.....	196.8	- 198.2
Block Member:		
Limestone, dark gray, very finely crystalline.....	198.2	- 198.5
Fontana Formation:		
Shale, dark gray.....	198.5	- 203.4
Dennis Formation:		
Winterset Member:		
Limestone, light gray, very finely crystalline; contains fusulinids, crinoids, and algal material.....	203.4	- 212.0
Limestone, medium gray, very finely crystalline; contains fusulinids, and crinoids.....	212.0	- 213.2
Limestone, medium to dark gray, very finely crystalline; contains fusulinids and algal material.....	213.2	- 216.0
Limestone, light brownish gray, very finely crystalline; contains pyrite.....	216.0	- 220.0
Limestone, medium gray, very finely crystalline; contains pyrite.....	220.0	- 223.2
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	223.2	- 224.7
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, crinoids, and brachiopods.....	224.7	- 226.2
Shale, medium brown.....	226.2	- 226.5
Limestone, medium brownish gray, very finely crystalline.....	226.5	- 229.0
Stark Member:		
Shale, medium gray.....	229.0	- 230.0
Shale, black.....	230.0	- 232.8
Canville Member:		
Limestone, dark gray, very finely crystalline; contains fusulinids, pyrite and "black inclusions".....	232.8	- 233.4
Galesburg Formation:		
Shale, greenish gray.....	233.4	- 238.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Swope Formation:		
Bethany Falls Member:		
Limestone, brownish gray, very finely crystalline; contains pyrite.....	238.1	- 240.6
Shale, medium gray.....	240.6	- 241.0
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, and <u>Osagia</u>	241.0	- 242.0

Test Hole 15-80

Location: Sarpy County, SE SW NW NW sec. 18, T. 13 N., R. 13 E., approximately 1070 feet south of north section line, and 570 feet east of west section line.

Ground-level elevation: 1023.5 feet above mean sea level.

Started: June 13, 1980. Completed: June 13, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, yellowish brown.....	5.0	- 13.0
Silt, reddish brown.....	13.0	- 15.0
Silt, olive; contains sand, very fine.....	15.0	- 16.0
Silt, olive; contains limestone.....	16.0	- 17.0
Silt, olive, clayey.....	17.0	- 18.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Wyandotte Formation:		
Argentine Member:		
Limestone, orange gray, very finely crystalline; contains bryozoan, crinoids and algal material.....	18.0	- 19.0
Limestone, olive, very finely crystalline, interbedded with shale, olive.....	19.0	- 25.5
Limestone, brownish gray, very finely crystalline; contains brachiopods and algal material.....	25.5	- 26.5

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, brownish gray, very finely crystalline, interbedded with shale, brownish gray; contains brachiopods.....	26.5	- 29.2
Limestone, brownish gray, very finely crystalline; contains algal material.....	29.2	- 30.0
Limestone, brownish gray, very finely crystalline, interbedded with shale brownish gray.....	30.0	- 31.0
Limestone, dark gray, very finely crystalline; contains crinoids and fusulinids.....	31.0	- 31.5
Shale, medium gray.....	31.5	- 34.0
Limestone, brownish gray, very finely crystalline, interbedded with shale, dark gray.....	34.0	- 34.9
Limestone, brownish gray, very finely crystalline; contains fusulinids and crinoids.....	34.9	- 35.4
Limestone, dark gray, finely crystalline; contains crinoids.....	35.4	- 36.0
Limestone, medium gray, very finely crystalline; contains crinoids.....	36.0	- 37.0
Shale, medium gray.....	37.0	- 38.3
Limestone, dark gray, very finely crystalline; contains crinoids and pyrite...	38.3	- 39.2
Quindaro Member:		
Shale, medium gray.....	39.2	- 40.0
Shale, black.....	40.0	- 41.0
Frisbie Member:		
Limestone, medium gray, very finely crystalline; contains crinoids, fusulinids, algal material and "black inclusions".....	41.0	- 41.9
Lane Formation:		
Shale, dark gray.....	41.9	- 44.1
Shale, medium gray.....	44.1	- 48.8
Iola Formation:		
Raytown Member:		
Limestone, orange gray, very finely crystalline; contains brachiopods.....	48.8	- 51.0
Limestone, medium gray, very finely crystalline.....	51.0	- 52.0
Limestone, light gray, very finely crystalline; contains pseudo-oolites.....	52.0	- 53.0
Limestone, light brownish gray, very finely crystalline.....	53.0	- 57.1
Shale, medium gray.....	57.1	- 58.3
Limestone, reddish brown, very finely crystalline, interbedded with shale dark gray; contains crinoids and fusulinids.....	58.3	- 58.9
Chanute Formation:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	58.9	- 60.0
Shale, black.....	60.0	- 61.1
Shale, dark gray.....	61.1	- 63.0
Shale, dark to medium gray.....	63.0	- 65.1
Drum Formation:		
Limestone, reddish gray, irregular crystalline; contains, <u>Osagia</u> , fusulinids, crinoids, and pseudo-oolites.....	65.1	- 67.2
Limestone, reddish gray, irregular crystalline, interbedded with shale, greenish gray.	67.2	- 68.1
Limestone, brownish gray, very finely crystalline; contains <u>Osagia</u> , fusulinids, pseudo-oolites, and crinoids.....	68.1	- 71.4
Limestone, brownish gray, very finely crystalline, interbedded with shale, medium gray.....	71.4	- 75.8
Shale, dark gray.....	75.8	- 77.5
Limestone, dark gray, very finely crystalline; contains fusulinids.....	77.5	- 78.2
Quivira Formation:		
Shale, greenish gray.....	78.2	- 79.4
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	79.4	- 80.0
Limestone, reddish gray, very finely crystalline; contains pseudo-oolites.....	80.0	- 80.3
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, and crinoids.....	80.3	- 82.0
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	82.0	- 83.0
Limestone, brownish gray, very finely crystalline.....	83.0	- 87.8
Wea Member:		
Shale, medium gray.....	87.8	- 89.0
Shale, black.....	89.0	- 90.2
Fontana Formation:		
Shale, dark gray.....	90.2	- 93.0
Shale, greenish gray.....	93.0	- 98.5
Dennis Formation:		
Winterset Member:		
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, and algal material.....	98.5	- 109.1
Limestone, medium gray, very finely crystalline; contains fusulinids and algal material.....	109.1	- 120.4

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	120.4	- 122.7
Limestone, dark gray, irregular crystalline...	122.7	- 125.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	125.0	- 125.1
Limestone, medium to dark gray, very finely crystalline.....	125.1	- 125.2
Limestone, dark gray, very finely crystalline; contains crinoids.....	125.2	- 125.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	125.3	- 126.2
Stark Member:		
Shale, black.....	126.2	- 130.3
Shale, dark gray.....	130.3	- 131.5
Canville Member:		
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	131.5	- 132.4
Galesburg Formation:		
Shale, dark gray.....	132.4	- 134.0
Shale, medium gray, interbedded with limestone, medium gray.....	134.0	- 137.0

Test Hole 16-80

Location: Sarpy County, NW NW NE SW sec. 20, T. 13 N., R. 13 E., approximately 20 feet south of half section line, and 120 feet east of quarter section line.

Ground-level elevation: 1125.5 feet above mean sea level.

Started: June 10, 1980. Completed: June 10, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 6.0
Silt, olive brown, clayey.....	6.0	- 15.5
Silt, reddish brown, clayey.....	15.5	- 39.5

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Silt, yellowish brown, clayey.....	39.5	- 43.6
Pennsylvanian System - Missouri Series - Kansas City Group:		
Drum Formation:		
Limestone, orange brown, very finely crystalline; contains fusulinids, <u>Osagia</u> , and "black inclusions".....	43.6	- 44.5
Shale, orange gray.....	44.5	- 45.9
Limestone, light orange gray, very finely crystalline; contains brachiopods, abundant fusulinids and <u>Osagia</u>	45.9	- 48.2
Shale, light olive gray.....	48.2	- 49.8
Limestone, olive gray, very finely crystalline; contains fusulinids and "black inclusions".....	49.8	- 50.3
Shale, olive gray.....	50.3	- 51.0
Shale, medium gray.....	51.0	- 52.0
Shale, medium gray, interbedded with limestone, medium gray.....	52.0	- 54.8
Quivira Formation:		
Shale, dark gray.....	54.8	- 55.0
Shale, dark gray, limy.....	55.0	- 55.1
Shale, dark gray.....	55.1	- 55.5
Sarpy Formation:		
Westerville Member:		
Limestone, dark gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	55.5	- 58.0
Limestone, light gray, very finely crystalline; contains fusulinids and pyrite.....	58.0	- 62.6
Wea Member:		
Shale, medium gray.....	62.6	- 64.0
Shale, black, fissile.....	64.0	- 65.5
Block Member:		
Shale, medium gray, interbedded with limestone, medium gray.....	65.5	- 66.8
Fontana Formation:		
Shale, medium gray.....	66.8	- 71.0
Shale, olive gray.....	71.0	- 72.4
Dennis Formation:		
Winterset Member:		
Limestone, light gray, irregular crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and pyrite.....	72.4	- 81.5
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and pyrite.....	81.5	- 87.2
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids,		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Osagia, and pyrite.....	87.2	- 93.1
Shale, medium to dark gray, interbedded with limestone, medium to dark gray.....	93.1	- 96.3
Shale, medium gray, interbedded with limestone, medium gray.....	96.3	- 98.3
Limestone, medium to dark gray, very finely crystalline, interbedded with shale, medium to dark gray.....	98.3	- 101.6
Shale, medium gray.....	101.6	- 102.3
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, crinoids, pyrite and glauconite.....	102.3	- 103.0
Stark Member:		
Shale, medium gray.....	103.0	- 103.7
Shale, black, fissile.....	103.7	- 106.0
Canville Member:		
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	106.0	- 107.1
Limestone, medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, crinoids, and "black inclusions".....	107.1	- 109.2
Galesburg Formation:		
Shale, medium gray.....	109.2	- 111.1
Shale, medium gray, interbedded with limestone, medium gray.....	111.1	- 112.0
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, chert, and pyrite.....	112.0	- 113.6
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	113.6	- 114.5
Limestone, medium gray, very finely crystalline.....	114.5	- 115.0
Shale, medium gray, interbedded with limestone, medium gray.....	115.0	- 116.6
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	116.6	- 117.4
Limestone, light gray, very finely crystalline; contains fusulinids and pyrite.	117.4	- 118.7
Shale, medium gray.....	118.7	- 119.5
Limestone, light to medium gray, very finely crystalline.....	119.5	- 122.0
Limestone, brownish gray, very finely crystalline; contains algal material, pyrite, glauconite, and fluorite.....	122.0	- 123.7
Hushpuckney Member:		
Shale, medium gray, interbedded with limestone, medium gray.....	123.7	- 125.2

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium to dark gray.....	125.2	- 125.4
Ladore Formation:		
Shale, medium gray.....	125.4	- 130.0
Hertha Formation:		
Limestone, medium gray, very finely crystalline; contains abundant fusulinids, and pseudo-oolites.....	130.0	- 131.5
Shale, medium gray.....	131.5	- 137.0

Test Hole 17-80

Location: Sarpy County, NW corner SE sec. 20, T. 13 N., R. 13 E.,
approximately 8 feet south of half section line, and
2600 feet west of east section line.

Ground-level elevation: 1101.0 feet above mean sea level.

Started: June 11, 1980. Completed: June 11, 1980.

Total depth: 152.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, brown.....	0.0	- 9.0
Silt, olive brown, clayey.....	9.0	- 12.5
Silt, yellowish brown, clayey.....	12.5	- 13.0
Silt, olive, clayey.....	13.0	- 23.5
Silt, reddish brown, clayey.....	23.5	- 31.5
Silt, brown, clayey.....	31.5	- 36.0
Silt, olive, clayey.....	36.0	- 42.0
Sand, very fine to coarse.....	42.0	- 47.0
Clay, olive.....	47.0	- 48.0
Sand, very fine to coarse.....	48.0	- 49.5

Pennsylvanian System - Missouri Series - Kansas City Group:

Dennis Formation:

Winterset Member:

Limestone, orange gray, very finely crystal- line; contains pseudo-oolites, and <u>Osagia</u> ...	49.5	- 50.5
Limestone, light gray, very finely crystalline; contains fusulinids, pseudo- oolites, and algal material.....	50.5	- 56.5

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, olive.....	56.5	- 57.0
Limestone, olive gray, very finely crystalline; contains fusulinids and pseudo-oolites.....	57.0	- 59.5
Limestone, light gray, very finely crystalline; contains algal material.....	59.5	- 60.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	60.0	- 68.1
Shale, medium gray.....	68.1	- 70.1
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	70.1	- 71.1
Limestone, medium gray, very finely crystalline; contains fusulinids.....	71.1	- 72.2
Limestone, dark gray, very finely crystalline; contains crinoids.....	72.2	- 72.6
Limestone, medium gray, very finely crystalline; contains crinoids, and pseudo-oolites.....	72.6	- 73.2
Shale, medium gray.....	73.2	- 74.1
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, crinoids, and glauconite.....	74.1	- 74.4
Stark Member:		
Shale, medium gray.....	74.4	- 75.5
Shale, black.....	75.5	- 78.0
Shale, dark gray.....	78.0	- 78.2
Canville Member:		
Limestone, dark gray, very finely crystalline; contains brachiopods and pyrite.....	78.2	- 78.3
Shale, medium gray.....	78.3	- 79.0
Limestone, light gray, very finely crystalline; contains fusulinids, pseudo-oolites, and <u>Osagia</u>	79.0	- 80.8
Galesburg Formation:		
Shale, medium gray.....	80.8	- 82.5
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, algal material, and pyrite.....	82.5	- 85.1
Shale, medium gray.....	85.1	- 87.0
Limestone, medium gray, very finely crystalline; contains crinoids, algal material, and pyrite.....	87.0	- 87.4
Shale, medium gray, interbedded with limestone, medium gray.....	87.4	- 88.0
Limestone, medium gray, irregular crystalline; contains <u>Osagia</u> , algal material,		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
and pyrite.....	88.0	- 88.7
Shale, medium gray, interbedded with limestone, medium gray.....	88.7	- 89.0
Limestone, light gray, very finely crystalline; contains pseudo-oolites, crinoids, and pyrite.....	89.0	- 91.1
Shale, medium gray, interbedded with limestone, medium gray.....	91.1	- 91.9
Limestone, light brownish gray, very finely crystalline; contains fusulinids, and algal material.....	91.9	- 92.2
Limestone, light gray, irregular crystalline; contains bryozoan.....	92.2	- 93.7
Limestone, brownish gray, irregular crystalline.....	93.7	- 95.0
Hushpuckney Member:		
Shale, medium gray.....	95.0	- 96.0
Shale, black.....	96.0	- 96.1
Ladore Member:		
Shale, dark gray.....	96.1	- 97.0
Shale, medium to dark gray.....	97.0	- 102.9
Hertha Formation:		
Limestone, brownish gray, very finely crystalline, interbedded with shale, greenish gray; contains pyrite.....	102.9	- 103.9
Shale, greenish gray.....	103.9	- 108.7
Limestone, brownish gray, very finely crystalline, interbedded with shale, brownish gray.....	108.7	- 111.2
Limestone, brownish gray, irregular crystalline; contains <u>Osagia</u> , fusulinids, crinoids, and pyrite.....	111.2	- 112.0
Des Moines Series - Marmaton Group:		
Shale, greenish gray.....	112.0	- 115.0
Shale, red.....	115.0	- 117.8
Shale, dark red, with gray mottling.....	117.8	- 121.1
Shale, greenish gray.....	121.1	- 122.4
Shale, red.....	122.4	- 130.4
Shale, greenish gray.....	130.4	- 132.0
Shale, greenish gray, interbedded with limestone, greenish gray.....	132.0	- 136.1
Limestone, medium gray, very finely crystalline, interbedded with shale, greenish gray; contains crinoids.....	136.1	- 137.5
Shale, greenish gray.....	137.5	- 141.5
Shale, greenish gray with red mottling.....	141.5	- 144.2
Shale, red.....	144.2	- 146.1
Shale, red with olive mottling.....	146.1	- 152.0

Test Hole 18-80

Location: Sarpy County, NW NW SW NW sec. 20, T. 13N., R. 13E.,
approximately 1328 feet south of north section line
and 1500 feet east of west section line.

Ground-level elevation: 1130.5 feet above sea level.

Started: June 12, 1980. Completed: June 12, 1980.

Total depth: 167.0 feet.

	<u>Description</u>		<u>Depth, in feet</u>	
			<u>From</u>	<u>To</u>
Quaternary System:				
Silt, medium brown.....			0.0	- 7.5
Silt, olive.....			7.5	- 15.0
Silt, orange brown; contains sand, very fine..			15.0	- 22.5
Silt, olive.....			22.5	- 27.0
Silt, olive, clayey.....			27.0	- 48.0
Silt, olive brown, clayey.....			48.0	- 53.0
Clay, olive, silty.....			53.0	- 56.0
Clay, olive brown, silty.....			56.0	- 60.0
Silt, yellowish brown; contains sand, medium..			60.0	- 70.0
Silt, dark gray, clayey.....			70.0	- 90.0
Sand, very fine to very coarse; contains gravel fine.....			90.0	- 97.2
Pennsylvanian System - Missouri Series - Kansas City Group:				
Dennis Formation:				
Winterset Member:				
Shale, light yellow.....			97.2	- 97.5
Limestone, olive brown, irregular crystalline; contains crinoids.....			97.5	- 100.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....			100.0	- 105.0
Limestone, dark gray, very finely crystalline; contains brachiopods, crinoids, and pyrite..			105.0	- 105.5
Limestone, medium gray, very finely crystalline; contains algal material and pyrite.....			105.5	- 106.5
Shale, medium gray.....			106.5	- 107.2
Limestone, medium gray, very finely crystalline; contains crinoids, algal material, glauconite, and pyrite.....			107.2	- 107.5
Stark Member:				
Shale, medium gray.....			107.5	- 108.4
Shale, black.....			108.4	- 110.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray.....	110.0	- 111.0
Canville Member:		
Limestone, dark gray, very finely crystalline; contains algal material and pyrite.....	111.0	- 111.8
Shale, dark gray.....	111.8	- 112.0
Limestone, light gray, very finely crystal- line; contains crinoids, fusulinids, <u>Osagia</u> , and "black inclusions".....	112.0	- 114.1
Galesburg Formation:		
Shale, greenish gray.....	114.1	- 117.0
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, very finely crystal- line; contains algal material <u>Osagia</u> and pyrite.....	117.0	- 118.2
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray; contains crinoids and fusulinids.....	118.2	- 122.4
Limestone, light gray, irregular crystal- line; contains algal material.....	122.4	- 123.1
Shale, medium gray.....	123.1	- 124.0
Limestone, light gray, irregular crystalline; contains algal material.....	124.0	- 127.0
Limestone, light to medium gray, very finely crystalline; contains pyrite.....	127.0	- 128.7
Hushpuckney Member:		
Shale, medium gray.....	128.7	- 130.0
Shale, medium gray, interbedded with limestone, medium gray.....	130.0	- 130.2
Ladore Formation:		
Shale, medium gray.....	130.2	- 135.3
Hertha Formation:		
Limestone; medium gray, irregular crystal- line; contains <u>Osagia</u> , fusulinids, and algal material.....	135.3	- 137.0
Shale, greenish gray.....	137.0	- 138.2
Shale, red.....	138.2	- 139.0
Shale, greenish gray.....	139.0	- 144.0
Limestone, medium gray, irregular crystalline; contains fusulinids, crinoids and pyrite....	144.0	- 144.3
Shale, medium gray.....	144.3	- 144.5
Limestone, light brownish gray, very finely crystalline; contains crinoids, algal material, and pyrite.....	144.5	- 145.2
Des Moines Series - Marmaton Group:		
Shale, medium gray.....	145.2	- 147.0
Shale, medium to dark gray.....	147.0	- 148.2
Shale, red.....	148.2	- 154.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	154.0	- 155.8
Shale, red.....	155.8	- 156.5
Shale, medium gray.....	156.5	- 157.0
Shale, red.....	157.0	- 164.6
Limestone, medium gray, very finely crystalline; contains algal material.....	164.6	- 167.0

Test Hole 19-80

Location: Sarpy County, NW corner SW NE sec. 20, T. 13 N., R. 13 E.,
approximately 1335 feet south of north section line, and
2600 feet west of east section line.

Ground-level elevation: 1130.0 feet above mean sea level.

Started: June 13, 1980. Completed: June 13, 1980.

Total depth: 182.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Topsoil.....	0.0	- 4.0
Silt, olive.....	4.0	- 24.0
Silt, reddish brown.....	24.0	- 28.3
Silt, reddish brown, clayey.....	28.3	- 34.0
Silt, olive brown, clayey.....	34.0	- 40.7
Clay, olive brown.....	40.7	- 47.5
Clay, olive.....	47.5	- 54.0
Clay, olive brown.....	54.0	- 63.0
Clay, olive.....	63.0	- 65.0
Clay, dark gray.....	65.0	- 81.0
Clay, olive brown.....	81.0	- 82.0
Clay, olive brown.....	82.0	- 87.2

Pennsylvanian System - Missouri Series - Kansas City Group:

Dennis Formation:

Winterset Member:

Limestone, olive, very finely crystalline.....	87.2	- 88.0
Shale, olive.....	88.0	- 88.3
Limestone, olive gray, very finely crystalline.....	88.3	- 92.0
Limestone, medium gray, very finely crystalline; contains fusulinids and pyrite.	92.0	- 94.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	94.1	- 95.7
Limestone, medium gray, very finely crystalline.....	95.7	- 96.4
Shale, dark gray.....	96.4	- 96.8
Limestone, medium gray, very finely crystalline.....	96.8	- 97.7
Limestone, dark gray, very finely crystalline; contains crinoids.....	97.7	- 98.2
Limestone, medium gray, very finely crystalline; contains crinoids, algal material and pyrite.....	98.2	- 98.5
Shale, medium gray.....	98.5	- 100.0
Limestone, medium gray, very finely crystalline; contains crinoids, pyrite, and glauconite.....	100.0	- 100.2
Stark Member:		
Shale, medium gray.....	100.2	- 101.0
Shale, black, fissile.....	101.0	- 103.1
Canville Member:		
Limestone, dark gray, irregular crystalline; contains pyrite.....	103.1	- 103.2
Shale, dark gray.....	103.2	- 103.9
Limestone, dark gray, very finely crystalline; contains brachiopods, algal material, pyrite and "black inclusions".....	103.9	- 104.4
Shale, dark gray.....	104.4	- 104.9
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , algal material, and pyrite.....	104.9	- 106.8
Galesburg Formation:		
Shale, greenish gray.....	106.8	- 109.0
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystalline; contains brachiopods, fusulinids, and pyrite.....	109.0	- 110.6
Limestone, light to medium gray, interbedded with shale, medium gray; contains fusulinids.....	110.6	- 114.6
Shale, medium gray, interbedded with limestone, medium gray.....	114.6	- 115.0
Limestone, medium gray, very finely crystalline; contains pseudo-oolites.....	115.0	- 116.0
Shale, dark gray.....	116.0	- 116.6
Limestone, light brownish gray, very finely crystalline; contains brachiopods, fusulinids, chert, and pyrite.....	116.6	- 117.5
Limestone, light gray, very finely crystalline; contains crinoids, algal material, and pyrite.....	117.5	- 119.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, brownish gray, very finely crystalline; contains brachiopods, crinoids, and pyrite.....	119.8	- 120.6
Hushpuckney Member:		
Shale, medium gray, interbedded with limestone, medium gray.....	120.6	- 122.0
Shale, dark gray.....	122.0	- 122.8
Ladore Formation:		
Shale, medium to dark gray.....	122.8	- 125.5
Shale, medium gray, interbedded with limestone, medium gray.....	125.5	- 128.3
Hertha Formation:		
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, and crinoids.....	128.3	- 130.1
Shale, medium gray.....	130.1	- 130.4
Shale, olive.....	130.4	- 131.0
Shale, greenish gray.....	131.0	- 132.5
Shale, greenish gray, with red mottling.....	132.5	- 133.0
Shale, greenish gray.....	133.0	- 134.8
Shale, dark greenish gray.....	134.8	- 135.7
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	135.7	- 137.2
Shale, greenish gray.....	137.2	- 137.5
Limestone, medium gray, very finely crystalline; contains brachiopods, <u>Osagia</u> , and pseudo-oolites.....	137.5	- 138.3
Des Moines Series - Marmaton Group:		
Shale, greenish gray.....	138.3	- 141.2
Shale, red, with gray mottling.....	141.2	- 146.0
Shale, red.....	146.0	- 159.0
Shale, medium gray, interbedded with limestone, medium gray.....	159.0	- 161.0
Limestone, medium gray, very finely crystalline; contains fusulinids and brachiopods.....	161.0	- 161.7
Shale, greenish gray.....	161.7	- 167.0
Shale, greenish gray, with red mottling.....	167.0	- 169.0
Shale, red.....	169.0	- 176.0
Shale, red, with olive mottling.....	176.0	- 182.0

Test Hole 20-80

Location: Sarpy County, NE SW SW NE sec. 23, T. 13 N., R. 13 E.,
approximately 2100 feet south of north section line,
and 2300 feet west of east section line.

Ground-level elevation: 976.0 feet above mean sea level.

Started: June 14, 1980. Completed: June 14, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Topsoil.....	0.0	- 7.0
Silt, dark brown.....	7.0	- 13.0
Silt, dark brown, clayey.....	13.0	- 17.0
Silt, olive brown, clayey.....	17.0	- 20.0
Silt, dark gray, clayey.....	20.0	- 23.0
Silt, yellowish brown.....	23.0	- 24.0
Pennsylvanian System - Missouri Series - Lansing Group:		
Plattsburg Formation:		
Limestone, light gray, very finely crystal- line; contains fusulinids, <u>Osagia</u> , and pseudo-oolites.....	24.0	- 30.0
Shale, yellowish gray.....	30.0	- 32.0
Limestone, orange gray, very finely crystalline; crinoids, fusulinids, and <u>Osagia</u>	32.0	- 32.5
Limestone, light gray, very finely crystal- line; contains <u>Osagia</u>	32.5	- 33.5
Shale, medium gray.....	33.5	- 33.7
Limestone, light to medium gray, very finely crystalline; contains fusulinids, <u>Osagia</u> , and pseudo-oolites.....	33.7	- 33.9
Shale, dark gray, interbedded with lime- stone, dark gray.....	33.9	- 35.0
Limestone, dark gray, very finely crystalline; contains crinoids.....	35.0	- 37.2
Limestone, medium gray, very finely crystalline; contains crinoids, <u>Osagia</u> , and fusulinids.....	37.2	- 38.3
Kansas City Group:		
Bonner Springs Formation:		
Shale, olive gray.....	38.3	- 39.5
Shale, medium gray.....	39.5	- 40.3

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains brachiopods, and crinoids....	40.3	- 41.0
Shale, medium gray.....	41.0	- 45.0
Shale, red.....	45.0	- 46.2
Shale, medium gray, with red mottling.....	46.2	- 47.0
Shale, olive.....	47.0	- 47.5
Farley-Island Creek-Argentine Formations:		
Limestone, olive, very finely crystalline, intrbedded with shale, olive.....	47.5	- 49.0
Limestone, orange gray, very finely crystalline; contains fusulinids, and crinoids.....	49.0	- 50.7
Shale, light orange gray.....	50.7	- 51.4
Limestone, orange gray, very finely crystalline; contains fusulinids, <u>Osagia</u> , and pseudo-oolites.....	51.4	- 53.0
Limestone, light orange gray, very finely crystalline; contains pseudo-oolites and fusulinids.....	53.0	- 53.5
Limestone, light gray, very finely crystalline; contains pseudo-oolites.....	53.5	- 59.0
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids and <u>Osagia</u>	59.0	- 60.7
Limestone, light gray, very finely crystalline; contains algal material.....	60.7	- 61.2
Limestone, medium gray, very finely crystalline; contains crinoids, algal material and glauconite.....	61.2	- 62.4
Shale, medium gray.....	62.4	- 63.1
Shale, dark gray.....	63.1	- 63.3
Limestone, light gray, very finely crystalline.....	63.3	- 66.1
Shale, medium gray, interbedded with limestone, medium gray.....	66.1	- 66.9
Limestone, light brownish gray, very finely crystalline; contains brachiopods, <u>Osagia</u> and pseudo-oolites.....	66.9	- 69.0
Limestone, light to medium brownish gray, very finely crystalline; contains crinoids..	69.0	- 73.1
Shale, medium gray.....	73.1	- 76.5
Limestone, medium gray, very finely crystalline; contains crinoids.....	76.5	- 76.8
Shale, medium gray.....	76.8	- 77.5
Limestone, dark gray, very finely crystalline; contains crinoids.....	77.5	- 78.3
Limestone, light gray, very finely crystalline; contains crinoids and algal material.....	78.3	- 78.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark gray, very finely crystalline; contains crinoids.....	78.8	- 79.5
Limestone, light gray, very finely crystalline; contains crinoids.....	79.5	- 80.5
Shale, medium gray.....	80.5	- 81.4
Limestone, medium gray, very finely crystalline; contains crinoids, pseudo-oolites and algal material.....	81.4	- 82.5
Quindaro Member:		
Shale, medium gray.....	82.5	- 83.0
Shale, black.....	83.0	- 84.0
Frisbie Member:		
Limestone, medium gray, very finely crystalline; contains, fusulinids, crinoids, and <u>Osagia</u>	84.0	- 84.9
Shale, medium gray.....	84.9	- 85.3
Limestone, dark gray, very finely crystalline; contains crinoids.....	85.3	- 85.5
Lane Formation:		
Shale, medium gray.....	85.5	- 89.4
Shale, greenish gray.....	89.4	- 91.0
Shale, dark greenish gray.....	91.0	- 93.7
Iola Formation:		
Limestone, light gray, very finely crystalline, interbedded with shale, greenish gray.....	93.7	- 94.8
Limestone, light gray, very finely crystalline.....	94.8	- 102.4
Shale, greenish gray.....	102.4	- 103.1
Limestone, light gray, irregular crystalline..	103.1	- 103.7
Chanute Formation:		
Shale, greenish gray.....	103.7	- 104.5
Shale, black.....	104.5	- 106.0
Shale, dark gray.....	106.0	- 107.0
Shale, greenish gray.....	107.0	- 108.0
Shale, olive green.....	108.0	- 109.0
Shale, greenish gray.....	109.0	- 109.4
Shale, dark greenish gray.....	109.4	- 111.7
Drum Formation:		
Limestone, brownish gray, very finely crystalline; contains <u>Osagia</u> , fusulinids, and pseudo-oolites.....	111.7	- 112.0
Limestone, light gray, irregular crystalline; contains fusulinids, <u>Osagia</u> , and pseudo-oolites.....	112.0	- 113.1
Shale, medium gray.....	113.1	- 114.0
Limestone, light brownish gray, very finely crystalline; contains fusulinids, <u>Osagia</u> , and pseudo-oolites.....	114.0	- 115.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline, interbedded with shale, light gray.....	115.0	- 116.4
Limestone, light gray, very finely crystalline; contains fusulinids.....	116.4	- 117.0
Limestone, light gray, very finely crystalline, interbedded with shale, light gray.....	117.0	- 122.0
Quivira Formation:		
Shale, dark gray.....	122.0	- 123.0
Sarpy Formation:		
Westerville Member:		
Limestone, light gray, very finely crystalline; contains algal material.....	123.0	- 125.1
Limestone, light gray to white, very finely crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and algal material.....	125.1	- 129.0
Limestone, medium to dark gray, irregular crystalline; contains algal material, and pyrite.....	129.0	- 130.0
Limestone, medium gray, very finely crystalline; contains pyrite.....	130.0	- 133.7
Wea Member:		
Shale, medium gray.....	133.7	- 134.0
Shale, black.....	134.0	- 136.0
Block Member:		
Limestone, dark gray, very finely crystalline.....	136.0	- 136.1
Fontana Formation:		
Shale, medium gray.....	136.1	- 137.0

Test Hole 21-80

Location: Sarpy County, NE NE SW SW sec. 17, T. 13 N., R. 13 E., approximately 1300 feet north of south section line, and 1100 feet east of west section line.

Ground-level elevation: 1155.0 feet above mean sea level.

Started: June 16, 1980. **Completed:** June 16, 1980.

Total depth: 190.0 feet.

Description	Depth, in feet	
	From	To
Quaternary System:		
Silt, yellowish brown.....	0.0	- 15.2
Silt, olive.....	15.2	- 17.0
Clay, olive gray.....	17.0	- 19.5
Silt, brown.....	19.5	- 24.0
Silt, reddish brown.....	24.0	- 26.0
Clay, reddish brown.....	26.0	- 29.2
Clay, red.....	29.2	- 32.4
Clay, brown; contains sand, fine.....	32.4	- 35.0
Clay, yellowish brown; contains sand, fine....	35.0	- 40.0
Clay, tannish gray.....	40.0	- 48.0
Clay, light tannish gray.....	48.0	- 58.5
Clay, light gray.....	58.5	- 73.0
Clay, light gray; contains sand, medium.....	73.0	- 79.0
Sand, very fine, to very coarse; contains gravel, very fine.....	79.0	- 85.0
Clay, light gray.....	85.0	- 87.3
Pennsylvanian System - Missouri Series - Kansas City Group:		
Drum Formation:		
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	87.3	- 88.2
Shale, yellowish gray.....	88.2	- 89.0
Limestone, dark orange, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	89.0	- 90.0
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, and fusulinids.....	90.0	- 93.7
Limestone, light gray, very finely crystalline, interbedded with shale, light gray; contains fusulinids.....	93.7	- 96.0
Quivira Formation:		
Shale, dark gray.....	96.0	- 97.0
Shale, medium gray.....	97.0	- 99.1
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, brachiopods, and algal material.....	99.1	- 100.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	100.0	- 101.0
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and algal material.....	101.0	- 103.0
Limestone, medium gray, very finely crystalline; contains fusulinids.....	103.0	- 108.0

	<u>Description</u>	<u>Depth, in feet</u>	
		<u>From</u>	<u>To</u>
Wea Member:			
	Shale, medium gray.....	108.0	- 108.7
	Shale, black.....	108.7	- 110.5
Fontana Formation:			
	Shale, dark gray.....	110.5	- 114.6
	Shale, medium gray.....	114.6	- 118.7
Dennis Formation:			
Winterset Member:			
	Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and algal material.....	118.7	- 122.0
	Limestone, medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, and algal material.....	122.0	- 129.8
	Limestone, medium gray, very finely crystalline; contains fusulinids.....	129.8	- 134.4
	Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	134.4	- 137.6
	Limestone, medium gray, very finely crystalline; contains fusulinids.....	137.6	- 141.2
	Shale, medium gray.....	141.2	- 143.0
	Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	143.0	- 143.4
	Limestone, dark gray, very finely crystalline, interbedded with shale, medium gray.....	143.4	- 144.0
	Limestone, dark gray, very finely crystalline; contains fusulinids and crinoids.....	144.0	- 145.1
	Shale, medium gray.....	145.1	- 147.0
	Limestone, medium gray, very finely crystalline; contains crinoids, fusulinids, and pyrite.....	147.0	- 147.2
	Limestone, medium gray, very finely crystalline; contains fusulinids.....	147.2	- 148.0
Stark Member:			
	Shale, black.....	148.0	- 150.6
Canville Member:			
	Limestone, medium gray, very finely crystalline; contains brachiopods, crinoids, and algal material.....	150.6	- 153.4
Galesburg Formation:			
	Shale, greenish gray.....	153.4	- 154.0
Swope Formation:			
Bethany Falls Member:			
	Limestone, light gray, very finely crystalline, interbedded with shale, greenish gray.	154.0	- 155.6

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline; contains algal material.....	155.6	- 157.8
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	157.8	- 161.9
Limestone, light gray, very finely crystalline; contains algal material.....	161.9	- 162.7
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	162.7	- 163.8
Limestone, light brownish gray, very finely crystalline; contains algal material.....	163.8	- 165.1
Limestone, light gray, very finely crystalline; contains algal material and <u>Osagia</u>	165.1	- 165.3
Limestone, brownish gray, irregular crystalline; contains algal material.....	165.3	- 167.1
Limestone, dark brownish gray, very finely crystalline; contains crinoids.....	167.1	- 167.5
Limestone, brownish gray, very finely crystalline; contains brachiopods, and crinoids.....	167.5	- 168.9
Hushpuckney Member:		
Shale, medium gray.....	168.9	- 169.5
Shale, black.....	169.5	- 170.0
Ladore Formation:		
Shale, medium to dark gray.....	170.0	- 175.8
Hertha Formation:		
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	175.8	- 177.9
Shale, greenish gray.....	177.9	- 178.5
Shale, dark red.....	178.5	- 182.0
Shale, greenish gray.....	182.0	- 183.1
Limestone, light gray, very finely crystalline, interbedded with, shale, greenish gray.....	183.1	- 185.0
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	185.0	- 185.5
Des Moines Series - Marmaton Group:		
Shale, greenish gray.....	185.5	- 187.0
Shale, dark red.....	187.0	- 189.0
Shale, dark red, with olive mottling.....	189.0	- 190.0

Test Hole 22-80

Location: Sarpy County, SE SW NE SE sec. 18, T. 13 N., R. 13 E.,
approximately 1350 feet north of south section line,
and 950 feet west of east section line.

Ground-level elevation: 1077.5 feet above mean sea level.

Started: June 17, 1980. Completed: June 17, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Topsoil.....	0.0	- 3.0
Silt, olive gray, clayey.....	3.0	- 16.0
Silt, yellowish brown, clayey.....	16.0	- 23.5
Silt, reddish brown, clayey.....	23.5	- 27.0
Clay, reddish gray.....	27.0	- 29.0
Clay, reddish brown.....	29.0	- 32.5
Silt, reddish brown; contains sand, very fine to fine.....	32.5	- 32.7
Pennsylvanian System - Missouri Series - Kansas City Group:		
Dennis Formation:		
Winterset Member:		
Limestone, orange, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids and crinoids.....	32.7	- 37.0
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, crinoids, and algal material.....	37.0	- 39.2
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, and crinoids.....	39.2	- 43.4
Limestone, light gray, irregular crystalline; contains pseudo-oolites, fusulinids, brachiopods, and crinoids.....	43.4	- 44.5
Limestone, medium gray, very finely crystalline; contains fusulinids.....	44.5	- 47.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	47.3	- 50.0
Limestone, medium gray, very finely crystalline; contains fusulinids.....	50.0	- 51.0
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	51.0	- 56.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray, interbedded with limestone, dark gray.....	56.8	- 59.3
Limestone, dark gray, very finely crystalline; contains crinoids.....	59.3	- 60.9
Limestone, medium gray, very finely crystalline; contains crinoids.....	60.9	- 62.4
Shale, greenish gray.....	62.4	- 62.8
Limestone, greenish gray, very finely crystalline; contains crinoids, <u>Osagia</u> , and glauconite.....	62.8	- 63.2
Stark Member:		
Shale, greenish gray.....	63.2	- 63.4
Shale, black.....	63.4	- 65.4
Shale, dark gray.....	65.4	- 65.5
Canville Member:		
Limestone, dark gray, very finely crystalline; contains fusulinids, and crinoids.....	65.5	- 66.3
Shale, dark gray.....	66.3	- 66.9
Limestone, dark gray, very finely crystalline; contains fusulinids, crinoids, <u>Osagia</u> , and pyrite.....	66.9	- 69.1
Galesburg Formation:		
Shale, greenish gray.....	69.1	- 71.0
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystal- line; contains fusulinids, <u>Osagia</u> and algal material.....	71.0	- 74.1
Shale, medium gray.....	74.1	- 74.9
Limestone, medium gray, very finely crystalline, interbedded with shale, green- ish gray.....	74.9	- 76.0
Limestone, medium gray, very finely crystalline; contains algal material.....	76.0	- 76.8
Limestone, light to medium gray, very finely crystalline.....	76.8	- 78.1
Limestone, medium gray, very finely crystal- line, interbedded with shale, dark gray.....	78.1	- 78.7
Limestone, medium brownish gray, very finely crystalline; contains crinoids.....	78.7	- 79.2
Limestone, light to medium gray, irregular crystalline.....	79.2	- 81.9
Limestone, medium brownish gray, very finely crystalline; contains fusulinids, algal material, and pyrite.....	81.9	- 82.3
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	82.3	- 83.4
Hushpuckney Member:		
Shale, dark gray.....	83.4	- 85.2

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, black.....	85.2	- 85.3
Ladore Member:		
Shale, medium to dark gray.....	85.3	- 90.2
Hertha Formation:		
Limestone, medium gray, irregular crystal- line; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	90.2	- 92.1
Shale, greenish gray.....	92.1	- 95.0
Shale, greenish gray, with red mottling.....	95.0	- 97.9
Limestone, medium gray, very finely crystalline, interbedded with shale, green- ish gray.....	97.9	- 100.2
Shale, greenish gray.....	100.2	- 100.7
Limestone, greenish gray, very finely crystalline; contains fusulinids and crinoids.....	100.7	- 101.4
Des Moines Series - Marmaton Group:		
Shale, dark greenish gray.....	101.4	- 102.9
Shale, dark red, with olive mottling.....	102.9	- 108.0
Shale, olive, with red mottling.....	108.0	- 110.0
Shale, dark red.....	110.0	- 120.9
Shale, greenish gray, interbedded with limestone, greenish gray.....	120.9	- 123.4
Limestone, medium gray, very finely crystalline, interbedded with shale, green- ish gray.....	123.4	- 124.0
Shale, greenish gray.....	124.0	- 134.0
Shale, dark red.....	134.0	- 137.0

Test Hole 23-80

Location: Sarpy County, SW SW NW SW sec. 18, T. 13 N., R. 13 E.,
approximately 1350 feet north of south section line,
and 125 feet east of west section line.

Ground-level elevation: 1027.0 feet above mean sea level.

Started: June 17, 1980. Completed: June 17, 1980.

Total depth: 152.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Topsoil.....	0.0	- 9.0
Silt, dark brown.....	9.0	- 15.5
Silt, dark brown, clayey.....	15.5	- 19.0
Silt, dark bluish gray.....	19.0	- 38.0
Silt, dark bluish gray, clayey.....	38.0	- 45.0
Silt, medium gray.....	45.0	- 56.0
Sand, very fine to very coarse; contains gravel very fine to coarse.....	56.0	- 64.5
Pennsylvanian System - Des Moines Series - Marmaton Group:		
Shale, orange.....	64.5	- 65.0
Limestone, light gray, very finely crystal- line; contains algal material.....	65.0	- 65.5
Shale, greenish gray.....	65.5	- 70.0
Shale, greenish gray, with red mottling.....	70.0	- 78.0
Shale, red.....	78.0	- 86.0
Shale, red, with olive mottling.....	86.0	- 91.0
Shale, dark gray.....	91.0	- 92.0
Limestone, dark brownish gray, very finely crystalline; contains brachiopods.....	92.0	- 92.4
Shale, dark gray.....	92.4	- 92.6
Shale, black.....	92.6	- 92.8
Shale, dark gray, interbedded with limestone, dark gray.....	92.8	- 93.7
Shale, olive gray.....	93.7	- 94.0
Limestone, reddish gray, very finely crystalline; contains pyrite.....	94.0	- 97.6
Shale, olive gray.....	97.6	- 104.5
Shale, medium to dark gray.....	104.5	- 106.3
Limestone, medium gray, very finely crystalline.....	106.3	- 106.8
Shale, medium gray.....	106.8	- 108.7
Limestone, medium gray, finely crystalline; contains pyrite.....	108.7	- 109.0
Shale, medium gray.....	109.0	- 112.2
Shale, dark gray.....	112.2	- 123.9
Shale, dark gray, interbedded with limestone, dark gray.....	123.9	- 124.8
Shale, medium to dark gray, interbedded with limestone, medium to dark gray.....	124.8	- 126.2
Limestone, brownish gray, very finely crystalline; contains algal material and glauconite.....	126.2	- 127.1
Shale, greenish gray.....	127.1	- 129.3
Limestone, light gray, very finely crystal- line; contains pyrite and algal material....	129.3	- 131.2
Shale, medium gray.....	131.2	- 132.5
Shale, dark gray.....	132.5	- 134.3
Shale, black.....	134.3	- 134.4

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystal- line; contains algal material.....	134.4	- 137.0
Shale, medium to dark gray.....	137.0	- 139.2
Shale, medium gray, with interbedded lime- stone, medium gray.....	139.2	- 140.0
Limestone, medium gray, very finely crystal- line; contains pseudo-oolites.....	140.0	- 142.1
Shale, medium gray.....	142.1	- 143.4
Shale, black.....	143.4	- 145.3
Shale, medium gray.....	145.3	- 147.0
Shale, dark red.....	147.0	- 148.6
Shale, olive.....	148.6	- 151.5
Shale, olive, interbedded with limestone, olive.....	151.5	- 152.0

Test Hole 24-80

Location: Sarpy County, SE corner sec. 10, T. 13 N., R. 12 E.,
approximately 22 feet north of south section line,
and 188 feet west of east section line.

Ground-level elevation: 1077.5 feet above mean sea level.

Started: June 17, 1980. Completed: June 17, 1980.

Total depth: 182.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 7.0
Silt, dark brown.....	7.0	- 11.0
Silt, medium brown.....	11.0	- 26.0
Silt, dark brown gray, clayey.....	26.0	- 30.1
Silt, dark gray, clayey.....	30.1	- 32.5
Clay, medium brown.....	32.5	- 39.0
Silt, medium gray, clayey.....	39.0	- 49.5
Sand, very fine to very coarse; contains gravel, very fine to very coarse.....	49.5	- 52.0
Gravel, fine to coarse.....	52.0	- 71.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Ladore Formation:		
Shale, brownish yellow.....	71.0	- 75.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	75.0	- 78.1
Hertha Formation:		
Limestone, medium gray, irregular crystalline; contains <u>Osagia</u> , fusulinids, pseudo- oolites, and pyrite.....	78.1	- 79.7
Shale, greenish gray.....	79.7	- 87.0
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids, crinoids, <u>Osagia</u> and pyrite.....	87.0	- 88.2
Shale, greenish gray.....	88.2	- 89.3
Limestone, brownish gray, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, and crinoids.....	89.3	- 90.3
Des Moines Series - Marmaton Group:		
Shale, greenish gray.....	90.3	- 100.1
Shale, dark red.....	100.1	- 103.4
Shale, dark red, with gray mottling.....	103.4	- 104.0
Shale, dark red.....	104.0	- 107.9
Limestone, medium gray, very finely crystalline; contains crinoids, and fusulinids.....	107.9	- 109.0
Limestone, greenish gray, very finely crystalline, interbedded with shale, green- ish gray.....	109.0	- 110.2
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	110.2	- 110.5
Limestone, medium gray, very finely crystalline; contains fusulinids, <u>Osagia</u> , crinoids, and pyrite.....	110.5	- 111.1
Shale, medium to dark gray.....	111.1	- 113.4
Shale, greenish gray.....	113.4	- 120.0
Shale, greenish gray, with red mottling.....	120.0	- 124.0
Shale, dark red.....	124.0	- 125.2
Shale, greenish gray.....	125.2	- 127.0
Shale, dark red.....	127.0	- 130.1
Shale, dark red, with yellowish brown mottling.....	130.1	- 134.8
Shale, dark gray.....	134.8	- 137.4
Limestone, dark gray, very finely crystalline; contains <u>Osagia</u>	137.4	- 138.0
Shale, dark greenish gray.....	138.0	- 141.1
Shale, dark olive gray.....	141.1	- 142.0
Shale, medium to dark gray.....	142.0	- 143.5
Limestone, medium gray, very finely crystalline; contains crinoids.....	143.5	- 144.8
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	144.8	- 145.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains crinoids and algal material.....	145.0	- 147.4
Shale, olive.....	147.4	- 149.6
Shale, medium gray.....	149.6	- 155.6
Shale, medium gray, with olive mottling.....	155.6	- 158.2
Shale, medium gray, with red mottling.....	158.2	- 160.1
Shale, dark gray.....	160.1	- 165.6
Shale, dark gray, interbedded with limestone, dark gray.....	165.6	- 166.0
Shale, black.....	166.0	- 166.1
Shale, medium gray.....	166.1	- 169.6
Shale, dark gray, interbedded with limestone, dark gray.....	169.6	- 170.0
Shale, medium gray.....	170.0	- 170.5
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	170.5	- 171.5
Limestone, medium gray, very finely crystalline; contains algal material and pyrite....	171.5	- 173.0
Shale, medium to dark gray.....	173.0	- 175.0
Shale, dark gray.....	175.0	- 176.1
Shale, dark gray, interbedded with limestone, dark gray.....	176.1	- 176.3
Shale, medium to dark gray.....	176.3	- 177.1
Shale, dark red, with gray mottling.....	177.1	- 177.8
Shale, dark gray.....	177.8	- 179.6
Limestone, light gray to white, very finely crystalline.....	179.6	- 182.0

Test Hole 25-80

Location: Sarpy County, SE SW SW SE sec. 8, T. 13 N., R. 12 E., approximately 21 feet north of south section line, and 492 feet east of half section line.

Ground-level elevation: 1147.0 feet above mean sea level.

Started: June 18, 1980. Completed: June 18, 1980

Total depth: 212.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 5.0
Silt, dark brown.....	5.0	- 7.0
Silt, medium brown, clayey.....	7.0	- 17.0
Silt, olive gray, clayey.....	17.0	- 21.5
Silt, light reddish brown, clayey.....	21.5	- 28.4
Clay, olive gray.....	28.4	- 38.0
Clay, dark gray.....	38.0	- 45.5
Sand, very fine to very coarse; contains gravel very fine to coarse.....	45.5	- 51.0
Clay, dark bluish gray.....	51.0	- 72.0
Clay, dark olive brown.....	72.0	- 77.0
Clay, very light gray to white.....	77.0	- 79.0
Clay, light brownish gray.....	79.0	- 82.0
Clay, reddish brown; contains sand, very fine to fine.....	82.0	- 84.0
Sand, very fine to medium.....	84.0	- 93.0
Sand, medium to very coarse; contains gravel, fine to coarse.....	93.0	- 95.0
Cretaceous System - Lower Cretaceous Series - Dakota Group:		
Clay, dark bluish gray.....	95.0	- 121.2
Pennsylvanian System - Missouri Series - Kansas City Group:		
Dennis Formation:		
Stark Member:		
Shale, black.....	121.2	- 122.1
Shale, dark gray.....	122.1	- 123.5
Canville Member:		
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	123.5	- 124.5
Galesburg Formation:		
Shale, medium gray.....	124.5	- 130.1
Shale, greenish gray.....	130.1	- 132.3
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystal- line, interbedded with shale, greenish gray.....	132.3	- 136.4
Limestone, light to medium gray, very finely crystalline, interbedded with shale, medium gray.....	136.4	- 139.8
Shale, medium to dark gray, interbedded with limestone, medium to dark gray.....	139.8	- 140.3
Limestone, brownish gray, very finely crystalline; contains pyrite.....	140.3	- 144.4
Hushpuckney Member:		
Shale, medium gray.....	144.4	- 146.3
Shale, black.....	146.3	- 146.4
Ladore Formation:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray.....	146.4	- 150.5
Hertha Formation:		
Limestone, brownish gray, very finely crystalline; contains abundant fusulinids, and pyrite.....	150.5	- 152.1
Shale, medium gray.....	152.1	- 156.3
Shale, greenish gray.....	156.3	- 160.9
Limestone, brownish gray, very finely crystalline; contains algal material.....	160.9	- 162.1
Shale, dark greenish gray.....	162.1	- 162.4
Limestone, brownish gray, very finely crystalline; contains abundant fusulinids, crinoids, and algal material.....	162.4	- 163.9
Des Moines Series - Marmaton Group:		
Shale, dark gray.....	163.9	- 172.6
Shale, greenish gray, interbedded with limestone, greenish gray.....	172.6	- 176.0
Shale, greenish gray.....	176.0	- 178.2
Shale, red.....	178.2	- 178.9
Shale, greenish gray.....	178.9	- 180.1
Shale, greenish gray, interbedded with limestone, greenish gray.....	180.1	- 182.0
Shale, greenish gray.....	182.0	- 182.4
Shale, greenish gray, interbedded with limestone, greenish gray.....	182.4	- 183.5
Shale, greenish gray.....	183.5	- 185.0
Shale, greenish gray, interbedded with limestone, greenish gray.....	185.0	- 190.5
Shale, greenish gray.....	190.5	- 192.0
Shale, red.....	192.0	- 194.8
Shale, greenish gray.....	194.8	- 195.5
Shale, red.....	195.5	- 198.0
Shale, red, with yellow mottling.....	198.0	- 206.2
Shale, dark gray.....	206.2	- 207.0
Shale, olive.....	207.0	- 207.2
Limestone, light gray to white, very finely crystalline.....	207.2	- 208.3
Shale, dark gray, with olive mottling.....	208.3	- 211.5
Shale, olive.....	211.5	- 212.0

Test Hole 26-80

Location: Sarpy County, NW NW SW NW sec. 18, T. 13 N., R. 12 E.,
approximately 1550 feet south of north section line,
and 25 feet east of west section line.

Ground-level elevation: 1104.5 feet above mean sea level.

Started: June 18, 1980. Completed: June 18, 1980.

Total depth: 300.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 6.0
Silt, medium brown.....	6.0	- 13.5
Silt, yellowish brown.....	13.5	- 22.0
Silt, medium brown.....	22.0	- 30.0
Sand, very fine to medium.....	30.0	- 33.5
Clay, dark bluish gray.....	33.5	- 64.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	64.0	- 71.5
Clay, dark bluish gray; contains sand, very fine to fine.....	71.5	- 74.0
Clay, yellowish brown; contains sand, very fine to fine.....	74.0	- 76.4
Sand, very fine to very coarse; contains gravel, fine to coarse.....	76.4	- 80.0
Cretaceous System - Lower Cretaceous Series - Dakota Group:		
Sand, very fine to fine.....	80.0	- 102.0
Sand, very fine to very coarse; contains gravel fine to coarse.....	102.0	- 112.0
Sand, very fine to medium.....	112.0	- 132.0
Sand, very fine to fine.....	132.0	- 152.0
Sand, very fine to very coarse; contains gravel, fine to coarse.....	152.0	- 167.0
Sand, very fine to coarse.....	167.0	- 182.0
Sand, very fine to very coarse; contains gravel, coarse.....	182.0	- 197.7
Clay, brownish yellow; contains sand, very fine.....	197.7	- 204.0
Clay, olive gray; contains sand, very fine....	204.0	- 205.1
Shale, medium gray.....	205.1	- 208.0
Shale, medium gray, with red mottling.....	208.0	- 211.2
Shale, red, with gray mottling.....	211.2	- 216.3

Pennsylvanian System - Des Moines Series - Marmaton Group:

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray.....	216.3	- 219.5
Shale, dark gray, interbedded with limestone, dark gray.....	219.5	- 219.7
Shale, greenish gray.....	219.7	- 221.5
Limestone, brownish gray, very finely crystalline, interbedded with shale, greenish gray.....	221.5	- 224.8
Shale, greenish gray.....	224.8	- 225.9
Shale, dark gray.....	225.9	- 227.0
Limestone, dark gray, very finely crystalline; contains fusulinids and <u>Osagia</u>	227.0	- 227.3
Shale, dark red.....	227.3	- 231.0
Shale, dark red, with gray mottling.....	231.0	- 231.4
Limestone, light gray, very finely crystalline; contains algal material.....	231.4	- 233.1
Limestone, light brownish gray, very finely crystalline; contains algal material.....	233.1	- 233.6
Shale, medium gray.....	233.6	- 235.2
Shale, medium gray, with red mottling.....	235.2	- 238.0
Limestone, brownish gray, irregular crystal- line; contains pseudo-oolites.....	238.0	- 239.1
Cherokee Group:		
Shale, black.....	239.1	- 241.5
Shale, medium gray.....	241.5	- 245.0
Shale, red, with gray mottling.....	245.0	- 246.2
Shale, olive.....	246.2	- 247.5
Shale, olive, interbedded with limestone, olive.....	247.5	- 248.0
Shale, olive.....	248.0	- 250.6
Shale, red.....	250.6	- 257.0
Shale, red, with olive mottling.....	257.0	- 263.4
Sandstone, dark gray, very fine to fine, well cemented.....	263.4	- 265.0
Sandstone, light gray, very fine to fine, well cemented.....	265.0	- 265.7
Sandstone, medium brown, very fine to fine, well cemented.....	265.7	- 269.6
Shale, medium to dark gray.....	269.6	- 271.2
Sandstone, dark bluish gray, very fine to fine, well cemented.....	271.2	- 272.1
Shale, medium gray.....	272.1	- 273.0
Shale, olive.....	273.0	- 276.0
Shale, olive brown.....	276.0	- 277.3
Shale, red, interbedded with limestone, medium gray.....	277.3	- 279.0
Limestone, brownish gray, very finely crystalline.....	279.0	- 279.6

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, multi-colored.....	279.6	- 289.5
Shale, greenish gray.....	289.5	- 292.0
Devonian System:		
Dolomite, medium brown, finely crystalline....	292.0	- 300.0

Test Hole 27-80

Location: Sarpy County, NW NW NW NW sec. 12, T. 13 N., R. 12 E.,
approximately 105 feet south of north section line,
and 22 feet east of west section line.

Ground-level elevation: 1101.5 feet above mean sea level.

Started: June 20, 1980. Completed: June 20, 1980.

Total depth: 257.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 3.0
Silt, yellowish brown, clayey.....	3.0	- 13.5
Silt, olive gray, clayey.....	13.5	- 28.0
Silt, reddish brown, clayey.....	28.0	- 39.0
Silt, yellow reddish brown, clayey.....	39.0	- 82.0
Clay, olive gray.....	82.0	- 90.0
Clay, light gray.....	90.0	- 104.0
Clay, light gray; contains sand, very fine to fine.....	104.0	- 116.9
Sand, very fine to coarse.....	116.9	- 124.5
Clay, olive gray; contains sand, medium.....	124.5	- 137.0
Cretaceous System - Lower Cretaceous Series - Dakota Group:		
Sand, very fine to fine.....	137.0	- 152.0
Sand, very fine to very coarse; contains gravel, medium.....	152.0	- 162.5
Shale, orange yellow.....	162.5	- 165.2
Shale, orange yellow; contains some sand, very fine.....	165.2	- 166.7
Shale, greenish gray.....	166.7	- 167.0

Pennsylvanian System - Des Moines Series - Marmaton Group:

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, red.....	167.0	- 169.5
Shale, red, with olive mottling.....	169.5	- 170.5
Shale, red.....	170.5	- 176.0
Shale, red, with olive mottling.....	176.0	- 179.5
Shale, dark gray.....	179.5	- 181.1
Limestone, dark gray, very finely crystalline; contains algal material and pyrite.....	181.1	- 181.4
Shale, medium to dark gray.....	181.4	- 182.0
Limestone, dark gray, very finely crystalline; contains algal material.....	182.0	- 183.0
Shale, dark gray.....	183.0	- 184.5
Shale, medium gray.....	184.5	- 187.1
Limestone, dark greenish gray, irregular crystalline; contains pyrite.....	187.1	- 190.4
Shale, greenish gray.....	190.4	- 191.0
Limestone, greenish gray, very finely crystalline, interbedded with shale, greenish gray.....	191.0	- 193.1
Limestone, olive gray, very finely crystal- line, interbedded with shale, olive gray....	193.1	- 194.5
Shale, olive.....	194.5	- 196.0
Shale, medium greenish gray.....	196.0	- 203.0
Shale, dark gray.....	203.0	- 210.7
Limestone, dark gray, very finely crystal- line; contains fusulinids and pyrite.....	210.7	- 211.2
Shale, black.....	211.2	- 211.3
Shale, greenish gray.....	211.3	- 212.1
Limestone, dark gray, very finely crystal- line; contains algal material and "black inclusions".....	212.1	- 212.9
Shale, black.....	212.9	- 213.4
Shale, dark gray.....	213.4	- 215.0
Shale, greenish gray, interbedded with lime- stone, greenish gray.....	215.0	- 218.1
Limestone, dark gray, very finely crystalline.	218.1	- 218.5
Limestone, greenish gray, very finely crystalline; contains crinoids.....	218.5	- 219.0
Shale, greenish gray.....	219.0	- 219.4
Shale, dark gray.....	219.4	- 223.1
Limestone, medium gray, irregular crystalline.	223.1	- 224.0
Limestone, light gray to white, very finely crystalline; contains pyrite, glauconite, and algal material.....	224.0	- 228.4
Shale, greenish gray.....	228.4	- 232.1
Limestone, brownish gray, very finely crystalline; contains pseudo-oolites, crinoids, and algal material.....	232.1	- 234.2
Cherokee Group:		
Shale, black.....	234.2	- 236.9

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, reddish gray.....	236.9	- 241.5
Shale, olive.....	241.5	- 242.7
Shale, red.....	242.7	- 244.9
Shale, olive red.....	244.9	- 253.2
Shale, red.....	253.2	- 255.6
Shale, olive red.....	255.6	- 257.0

Test Hole 28-80

Location: Sarpy County, SW SE SE SW sec. 3, T. 13 N., R. 12 E.,
approximately 26.5 feet north of south section line,
and 3150 feet west of east section line.

Ground-level elevation: 1147.0 feet above mean sea level.

Started: June 23, 1980. Completed: June 23, 1980.

Total depth: 317.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 6.0
Silt, olive gray, clayey.....	6.0	- 14.0
Silt, light olive gray, clayey.....	14.0	- 24.0
Silt, reddish brown, clayey.....	24.0	- 28.5
Clay, reddish brown.....	28.5	- 36.0
Silt, orange brown, clayey.....	36.0	- 49.0
Clay, reddish brown; contains sand, very fine to fine.....	49.0	- 57.0
Sand, very fine to coarse.....	57.0	- 58.5
Clay, olive gray; contains sand, very fine to fine.....	58.5	- 89.0
Clay, medium gray; contains sand, very fine to fine.....	89.0	- 90.5

Pennsylvanian System - Missouri Series - Kansas City Group:

Sarpy Formation:

Westerville Member:

Limestone, medium brown, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	90.5	- 94.1
Limestone, light to medium brown, very finely crystalline; contains pseudo-oolites,		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
fusulinids, and <u>Osagia</u>	94.1	- 94.8
Limestone, orange brown, very finely crystalline; contains pseudo-oolites, and <u>Osagia</u>	94.8	- 97.0
Shale, orange yellow.....	97.0	- 100.0
Wea Member:		
Shale, olive gray.....	100.0	- 101.0
Shale, black.....	101.0	- 103.0
Fontana Formation:		
Shale, olive gray.....	103.0	- 111.4
Dennis Formation:		
Winterset Member:		
Limestone, light brown, very finely crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and pyrite.....	111.4	- 112.8
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and pyrite.....	112.8	- 117.1
Limestone, medium to dark gray, very finely crystalline, interbedded with shale, light to medium gray.....	117.1	- 117.8
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and crinoids.....	117.8	- 122.4
Limestone, light to medium gray, very finely crystalline, interbedded with shale, light to medium gray.....	122.4	- 130.0
Shale, medium gray, with interbedded lime- stone, medium gray.....	130.0	- 134.7
Limestone, dark gray, very finely crystal- line.....	134.7	- 136.0
Shale, medium gray.....	136.0	- 137.3
Limestone, dark gray, very finely crystal- line, interbedded with shale, medium gray...	137.3	- 138.0
Shale, medium gray, interbedded with lime- stone, medium gray.....	138.0	- 139.8
Limestone, dark gray, very finely crystal- line; contains crinoids.....	139.8	- 140.6
Stark Member:		
Shale, medium gray.....	140.6	- 141.0
Shale, black.....	141.0	- 143.1
Canville Member:		
Limestone, dark gray, very finely crystal- line.....	143.1	- 143.3
Shale, dark gray.....	143.3	- 144.0
Limestone, dark gray, very finely crystal- line; contains crinoids, algal material, and pyrite.....	144.0	- 144.7
Galesburg Formation:		
Shale, dark greenish gray.....	144.7	- 146.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, crinoids, <u>Osagia</u> , and pyrite.....	146.1	- 147.2
Shale, greenish gray.....	147.2	- 150.2
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	150.2	- 152.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray.....	152.3	- 156.0
Limestone, light gray, very finely crystalline; contains algal material.....	156.0	- 157.0
Shale, medium gray, interbedded with limestone, medium gray.....	157.0	- 158.0
Limestone, brownish gray, very finely crystalline; contains bryozoan and crinoids.....	158.0	- 158.3
Limestone, light gray, very finely crystalline; contains brachiopods, chert, and pyrite.....	158.3	- 162.0
Hushpuckney Member:		
Shale, medium gray.....	162.0	- 164.0
Shale, dark gray.....	164.0	- 164.2
Ladore Formation:		
Shale, medium gray.....	164.2	- 168.6
Hertha Formation:		
Limestone, light brownish gray, very finely crystalline; contains <u>Osagia</u> , and algal material.....	168.6	- 170.2
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	170.2	- 175.0
Shale, greenish gray.....	175.0	- 178.1
Limestone, medium gray, very finely crystalline; contains algal material.....	178.1	- 179.0
Shale, medium gray.....	179.0	- 179.7
Limestone, medium gray, very finely crystalline; contains fusulinids, algal material, and pyrite.....	179.7	- 180.6
Des Moines Series - Marmaton Group:		
Shale, medium gray.....	180.6	- 187.0
Shale, dark gray.....	187.0	- 188.0
Shale, dark gray, with red mottling.....	188.0	- 190.1
Shale, dark gray, with red mottling, interbedded with limestone, dark gray.....	190.1	- 190.3
Shale, red.....	190.3	- 198.0
Shale, red, interbedded with limestone, medium gray.....	198.0	- 200.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains algal material.....	200.1	- 200.5
Shale, greenish gray, with red mottling.....	200.5	- 216.6
Shale, red.....	216.6	- 225.9
Shale, dark gray.....	225.9	- 226.8
Limestone, medium gray, very finely crystalline; contains crinoids.....	226.8	- 227.9
Shale, olive.....	227.9	- 233.1
Shale, dark gray.....	233.1	- 234.5
Limestone, medium gray, very finely crystalline; contains pyrite.....	234.5	- 239.2
Shale, olive, interbedded with limestone, medium gray.....	239.2	- 240.0
Shale, olive.....	240.0	- 242.1
Shale, medium gray, with red mottling.....	242.1	- 244.0
Shale, dark gray.....	244.0	- 253.5
Shale, medium gray.....	253.5	- 257.0
Shale, greenish gray.....	257.0	- 260.7
Limestone, brownish gray, very finely crystalline; contains pyrite.....	260.7	- 261.8
Shale, medium gray.....	261.8	- 262.7
Shale, dark gray.....	262.7	- 264.8
Limestone, brownish gray.....	264.8	- 265.7
Shale, medium gray.....	265.7	- 267.8
Shale, medium gray, interbedded with limestone, medium gray.....	267.8	- 269.6
Shale, medium gray.....	269.6	- 274.8
Limestone, brownish gray, very finely crystalline; contains <u>Osagia</u> , and algal material.....	274.8	- 276.1
Cherokee Group:		
Shale, medium gray.....	276.1	- 277.0
Shale, black.....	277.0	- 278.4
Shale, dark gray.....	278.4	- 278.9
Shale, red.....	278.9	- 283.7
Shale, olive.....	283.7	- 284.5
Shale, medium gray.....	284.5	- 287.0
Shale, red.....	287.0	- 290.2
Limestone, medium gray, very finely crystalline; contains algal material.....	290.2	- 290.7
Shale, red.....	290.7	- 306.1
Shale, red, with gray mottling.....	306.1	- 307.0
Sandstone, olive gray, very fine to fine, well cemented.....	307.0	- 308.5
Shale, medium gray.....	308.5	- 310.0
Shale, olive.....	310.0	- 310.3
Shale, red.....	310.3	- 316.2
Shale, olive.....	316.2	- 317.0

Test Hole 29-80

Location: Sarpy County, NE NE NE NE sec. 1, T. 13 N., R. 12 E.,
approximately 110 feet south of north section line,
and 25 feet west of east section line.

Ground-level elevation: 1117.5 feet above mean sea level.

Started: June 19, 1980. Completed: June 19, 1980.

Total depth: 257.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, yellowish brown.....	0.0	- 6.0
Silt, olive gray.....	6.0	- 9.0
Silt, yellowish brown.....	9.0	- 10.5
Silt, olive gray.....	10.5	- 11.0
Silt, rust brown.....	11.0	- 17.5
Silt, reddish brown, clayey.....	17.5	- 22.0
Silt, yellowish red brown.....	22.0	- 25.0
Clay, yellowish brown, silty.....	25.0	- 33.0
Clay, olive gray.....	33.0	- 39.0
Clay, olive yellowish gray.....	39.0	- 47.0
Clay, olive yellowish gray; contains sand, medium.....	47.0	- 55.0
Clay, olive gray; contains sand, medium.....	55.0	- 60.0
Sand, very fine to coarse.....	60.0	- 62.0
Clay, medium gray.....	62.0	- 64.0
Clay, olive gray.....	64.0	- 67.0
Clay, yellowish brown.....	67.0	- 70.5
Clay, medium gray.....	70.5	- 72.0
Clay, olive gray.....	72.0	- 73.0
Clay, dark gray.....	73.0	- 77.0
Clay, dark bluish gray.....	77.0	- 92.0
Clay, dark bluish gray; contains sand, medium.	92.0	- 101.0
Clay, light gray; contains sand, medium.....	101.0	- 107.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	107.0	- 122.0
Cretaceous System - Lower Cretaceous Series - Dakota Group:		
Sand, very fine to fine.....	122.0	- 148.0
Clay, orange; contains sand, medium to coarse.	148.0	- 152.6
Sandstone, reddish gray, very fine, slightly cemented.....	152.6	- 152.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Pennsylvanian System - Missouri Series - Kansas City Group:		
Swope Formation:		
Bethany Falls Member:		
Limestone, brownish gray, very finely crystal- line; contains crinoids and "black inclusions".....	152.8	- 154.4
Hushpuckney Member:		
Shale, greenish gray.....	154.4	- 157.7
Shale, black.....	157.7	- 158.1
Ladore Formation:		
Shale, greenish gray.....	158.1	- 160.5
Shale, olive.....	160.5	- 161.5
Hertha Formation:		
Limestone, brownish gray, irregular crystal- line; contains glauconite.....	161.5	- 164.9
Shale, greenish gray.....	164.9	- 166.0
Shale, red.....	166.0	- 170.7
Shale, medium gray.....	170.7	- 171.2
Limestone, medium gray, very finely crystal- line; contains algal material.....	171.2	- 171.9
Des Moines Series - Marmaton Group:		
Shale, greenish gray.....	171.9	- 177.0
Shale, dark reddish gray.....	177.0	- 184.9
Shale, red.....	184.9	- 189.9
Limestone, brownish gray, very finely crystal- line; contains algal material.....	189.9	- 190.1
Shale, dark gray, with interbedded limestone, dark gray.....	190.1	- 191.1
Limestone, medium gray, very finely crystal- line.....	191.1	- 194.2
Limestone, dark gray, very finely crystal- line; contains algal material.....	194.2	- 195.8
Shale, greenish gray.....	195.8	- 201.0
Shale, greenish gray, interbedded with limestone, greenish gray.....	201.0	- 204.7
Limestone, very finely crystalline, inter- bedded with shale, greenish gray.....	204.7	- 210.0
Limestone, greenish gray, very finely crystal- line; contains crinoids.....	210.0	- 211.3
Shale, olive gray.....	211.3	- 212.5
Shale, red.....	212.5	- 218.0
Shale, dark gray.....	218.0	- 221.2
Limestone, medium gray, very finely crystal- line; contains algal material.....	221.2	- 221.7
Shale, medium gray.....	221.7	- 222.3
Limestone, reddish gray, very finely crystal- line; contains algal material.....	222.3	- 223.1

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray.....	223.1	- 225.8
Shale, olive gray.....	225.8	- 227.0
Shale, red.....	227.0	- 229.3
Limestone, brownish gray, very finely crystalline.....	229.3	- 231.2
Limestone, medium to dark gray, very finely crystalline; contains brachiopods.....	231.2	- 232.2
Limestone, brownish gray, very finely crystalline, interbedded with shale, brownish gray.	232.2	- 233.9
Shale, olive.....	233.9	- 237.0
Shale, medium gray.....	237.0	- 243.5
Shale, dark gray.....	243.5	- 244.0
Shale, dark gray, interbedded with limestone, dark gray.....	244.0	- 251.1
Shale, dark gray.....	251.1	- 251.9
Shale, black.....	251.9	- 252.0
Shale, dark gray.....	252.0	- 253.5
Shale, medium gray.....	253.5	- 254.0
Shale, black.....	254.0	- 254.9
Limestone, greenish gray, very finely crystalline; contains algal material and pyrite....	254.9	- 256.0
Shale, greenish gray.....	256.0	- 257.0

Test Hole 30-80

Location: Sarpy County, SE SW SE SW sec. 33, T. 14 N., R. 12 E., approximately 174 feet north of south section line, and 1800 feet east of west section line.

Ground-level elevation: 1082.0 feet above mean sea level.

Started: June 24, 1980. Completed: June 24, 1980.

Total depth: 167.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Clay, dark brownish gray.....	0.0	- 15.4
Clay, dark gray, silty.....	15.4	- 27.5
Clay, greenish gray.....	27.5	- 32.0
Clay, gray, with olive mottling.....	32.0	- 40.0

Description	Depth, in feet	
	From	To
Clay, medium gray; contains sand, medium to coarse.....	40.0	- 41.0
Clay, medium gray.....	41.0	- 47.0
Clay, dark reddish brown.....	47.0	- 53.5
Clay, medium reddish brown.....	53.5	- 56.0
Clay, olive; contains sand, medium.....	56.0	- 57.8
Clay, light olive; contains sand.....	57.8	- 60.7
Pennsylvanian System - Missouri Series - Kansas City Group:		
Sarpy Formation:		
Wea Member:		
Shale, black.....	60.7	- 62.0
Block Member:		
Limestone, medium to dark gray, very finely crystalline; contains fusulinids and pyrite.	62.0	- 62.2
Fontana Formation:		
Shale, medium to dark gray.....	62.2	- 71.1
Dennis Formation:		
Winterset Member:		
Limestone, light brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	71.1	- 74.5
Limestone, light gray, irregular crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , and bryozoans.....	74.5	- 83.0
Limestone, light gray, very finely crystalline; contains fusulinids.....	83.0	- 85.1
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	85.1	- 88.6
Shale, medium gray, interbedded with limestone, medium gray.....	88.6	- 92.0
Limestone, dark gray, very finely crystalline.	92.0	- 94.3
Shale, dark gray, interbedded with limestone, dark gray.....	94.3	- 97.3
Limestone, medium to dark gray, very finely crystalline; contains fusulinids.....	97.3	- 97.8
Limestone, dark gray, very finely crystalline; contains crinoids, and brachiopods....	97.8	- 99.1
Shale, medium gray.....	99.1	- 100.2
Limestone, medium to dark gray, irregular crystalline; contains crinoids, algal material, pyrite and glauconite.....	100.2	- 101.0
Stark Member:		
Shale, medium gray.....	101.0	- 101.8
Shale, black.....	101.8	- 104.2
Canville Member:		
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, and pyrite.....	104.2	- 104.3

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, dark gray.....	104.3	- 105.0
Limestone, dark gray, very finely crystalline; contains fusulinids, algal material and glauconite.....	105.0	- 105.7
Galesburg Formation:		
Shale, medium to dark gray.....	105.7	- 108.4
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystal- line; contains brachiopods, algal material, and crinoids.....	108.4	- 109.5
Limestone, medium gray, very finely crystal- line, interbedded with shale, greenish gray.	109.5	- 110.2
Limestone, light gray, very finely crystal- line; contains algal material, and <u>Osagia</u> ...	110.2	- 113.5
Limestone, light to medium gray, very finely crystalline, interbedded with shale, light to medium gray.....	113.5	- 117.0
Limestone, light to medium gray, very finely crystalline.....	117.0	- 118.1
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	118.1	- 120.2
Limestone, light brownish gray, irregular crystalline; contains chert.....	120.2	- 123.5
Hushpuckney Member:		
Shale, medium gray.....	123.5	- 125.3
Shale, medium to dark gray.....	125.3	- 125.9
Shale, dark gray.....	125.9	- 126.2
Galesburg Formation:		
Shale, medium to dark gray.....	126.2	- 129.9
Hertha Formation:		
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	129.9	- 133.2
Shale, greenish gray.....	133.2	- 141.0
Limestone, brownish gray, very finely crystal- line; contains fusulinids, <u>Osagia</u> , and pyrite.....	141.0	- 141.8
Shale, greenish gray.....	141.8	- 142.0
Limestone, brownish gray, very finely crystal- line; contains fusulinids, algal material and pyrite.....	142.0	- 142.9
Des Moines Series - Marmaton Group:		
Shale, medium to dark gray.....	142.9	- 147.3
Shale, dark gray.....	147.3	- 153.0
Shale, red.....	153.0	- 160.0
Shale, red, interbedded with limestone, medium gray.....	160.0	- 160.5

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	160.5	- 162.3
Limestone, medium to dark brownish gray, very finely crystalline; contains brachiopods, algal material, and pyrite.....	162.3	- 163.9
Shale, medium gray.....	163.9	- 167.0

Test Hole 31-80

Location: Sarpy County, SW NW SE NE sec. 20, T. 13 N., R. 13 E., approximately 2000 feet south of north section line, and 1250 feet west of east section line.

Ground-level elevation: 1054.0 feet above mean sea level.

Started: June 11, 1980. Completed: June 11, 1980.

Total depth: 137.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, dark brown.....	0.0	- 8.0
Silt, medium brown.....	8.0	- 10.0
Silt, olive, clayey.....	10.0	- 15.0
Clay, olive brown.....	15.0	- 22.0
Sand, very fine to very coarse; contains gravel, coarse.....	22.0	- 24.5
Silt, olive brown, clayey.....	24.5	- 26.5
Silt, black.....	26.5	- 29.5
Sand, medium to very coarse; contains gravel, very fine to coarse.....	29.5	- 32.0
Pennsylvanian System - Missouri Series - Kansas City Group:		
Chanute Formation:		
Shale, medium gray.....	32.0	- 33.8
Drum Formation:		
Limestone, light gray, irregular crystalline; contains pseudo-oolites, fusulinids, crinoids and <u>Osagia</u>	33.8	- 37.6
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	37.6	- 38.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	38.8	- 42.4
Shale, medium gray, interbedded with limestone, medium gray.....	42.4	- 45.1
Quivira Formation:		
Shale, dark gray.....	45.1	- 47.7
Sarpy Formation:		
Westerville Member:		
Limestone, medium gray, irregular crystalline; contains pseudo-oolites, fusulinids, crinoids, and brachiopods.....	47.7	- 49.4
Limestone, light gray, irregular crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	49.4	- 51.0
Limestone, brownish gray, very finely crystalline; contains pyrite.....	51.0	- 56.0
Wea Member:		
Shale, medium gray, interbedded with limestone, medium gray.....	56.0	- 57.0
Shale, black.....	57.0	- 58.5
Block Member:		
Limestone, medium gray, very finely crystalline.....	58.5	- 59.0
Fontana Formation:		
Shale, medium gray.....	59.0	- 67.0
Dennis Formation:		
Winterset Member:		
Limestone, light gray, very finely crystalline; contains pseudo-oolites, fusulinids, crinoids, <u>Osagia</u> , and brachiopods.....	67.0	- 77.0
Limestone, medium gray, very finely crystalline; contains pseudo-oolites, fusulinids, and crinoids.....	77.0	- 82.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	82.3	- 83.9
Limestone, medium gray, very finely crystalline; contains fusulinids, and crinoids....	83.9	- 88.7
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	88.7	- 89.0
Limestone, medium gray, very finely crystalline.....	89.0	- 91.2
Shale, medium gray.....	91.2	- 93.3
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	93.3	- 94.4
Limestone, dark gray, very finely crystalline; contains brachiopods, and crinoids....	94.4	- 96.6
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	96.6	- 97.0
Stark Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	97.0	- 97.5
Shale, black.....	97.5	- 99.5
Shale, dark gray.....	99.5	- 100.0
Canville Member:		
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	100.0	- 101.5
Shale, light gray.....	101.5	- 101.6
Limestone, light gray, very finely crystal- line; contains <u>Osagia</u> , algal material, and pyrite.....	101.6	- 103.5
Galesburg Formation:		
Shale, medium gray.....	103.5	- 105.9
Swope Formation:		
Bethany Falls Member:		
Limestone, medium gray, very finely crystal- line; contains <u>Osagia</u> , algal material, and pyrite.....	105.9	- 113.1
Limestone, medium gray, very finely crystal- line; contains interbedded shale, medium gray.....	113.1	- 113.8
Limestone, light brownish gray, very finely crystalline; contains crinoids.....	113.8	- 118.1
Hushpuckney Member:		
Shale, medium gray.....	118.1	- 122.0
Ladore Formation:		
Shale, olive.....	122.0	- 124.5
Shale, medium gray.....	124.5	- 126.8
Hertha Formation:		
Limestone, brownish gray, very finely crystal- line; contains fusulinids.....	126.8	- 128.0
Shale, medium gray.....	128.0	- 132.5
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	132.5	- 137.0

Test Hole 32-80

Location: Sarpy County, NE NE NW NE sec. 21, T. 14 N., R. 12 E.,
approximately 54 feet south of north section line,
and 1000 feet east of west section line.

Ground-level elevation: 1038.5 feet above mean sea level.

Started: June 24, 1980. Completed: June 24, 1980.

Total depth: 197.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 7.0
Silt, medium brown, clayey.....	7.0	- 12.0
Silt, olive gray, clayey.....	12.0	- 14.5
Silt, dark gray, clayey.....	14.5	- 21.0
Silt, dark bluish gray, clayey.....	21.0	- 33.0
Silt, dark gray, clayey.....	33.0	- 47.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	47.0	- 62.0
Sand, very fine to fine.....	62.0	- 64.0
Shale, olive gray.....	64.0	- 68.5
Shale, medium gray.....	68.5	- 74.0
Sand, very fine to fine.....	74.0	- 82.0
Sand, very fine to fine, interbedded with shale, medium gray.....	82.0	- 83.0
Sand, very fine to coarse.....	83.0	- 92.0
Sand, very fine to fine.....	92.0	- 102.0
Cretaceous System - Lower Cretaceous Series - Dakota Group:		
Shale, orange gray.....	102.0	- 107.0
Sand, very fine to fine.....	107.0	- 115.1
Pennsylvanian System - Missouri Series - Kansas City Group:		
Dennis Formation:		
Winterset Member:		
Limestone, brownish gray, very finely crystalline; contains abundant chert, and pyrite...	115.1	- 124.0
Shale, medium gray.....	124.0	- 124.9
Limestone, medium gray, irregular crystalline; contains pyrite.....	124.9	- 128.0
Limestone, medium to dark gray, very finely crystalline.....	128.0	- 130.2
Stark Member:		
Shale, black.....	130.2	- 133.0
Canville Member:		
Limestone, medium to dark gray, very finely crystalline; contains pyrite.....	133.0	- 133.6
Galesburg Formation:		
Shale, medium gray.....	133.6	- 135.9
Swope Formation:		
Bethany Falls Member:		
Shale, light gray, interbedded with limestone, light gray.....	135.9	- 140.1
Limestone, light gray, irregular crystalline; contains algal material.....	140.1	- 142.5
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	142.5	- 144.4
Limestone, light gray, very finely crystalline; contains algal material.....	144.4	- 146.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, light gray.....	146.8	- 147.7
Limestone, light brownish gray, irregular crystalline; contains algal material.....	147.7	- 152.0
Hushpuckney Member:		
Shale, medium to dark gray.....	152.0	- 154.0
Shale, black.....	154.0	- 154.8
Ladore Formation:		
Shale, medium to dark gray.....	154.8	- 158.9
Hertha Formation:		
Limestone, light brownish gray, irregular crystalline; contains algal material, pseudo-oolites, and glauconite.....	158.9	- 162.8
Shale, medium to dark gray.....	162.8	- 170.3
Limestone, medium gray, very finely crystalline; contains algal material.....	170.3	- 170.5
Shale, medium gray.....	170.5	- 171.2
Limestone, medium gray, irregular crystalline; contains algal material.....	171.2	- 171.5
Des Moines Series - Marmaton Group:		
Shale, medium to dark gray.....	171.5	- 174.0
Shale, medium to dark gray, with red mottling.	174.0	- 175.0
Shale, red.....	175.0	- 179.0
Shale, olive.....	179.0	- 182.0
Shale, red, interbedded with limestone, reddish gray.....	182.0	- 183.0
Shale, red.....	183.0	- 187.5
Shale, red, interbedded with shale, gray.....	187.5	- 189.0
Shale, medium gray, interbedded with limestone, medium gray.....	189.0	- 192.2
Shale, medium gray.....	192.2	- 194.7
Shale, red.....	194.7	- 197.0

Test Hole 33-80

Location: Sarpy County, SW SW SW NE sec. 28, T. 14 N., R. 13 E., approximately 39 feet north of half section line, and 2700 feet east of west section line.

Ground-level elevation: 1116.0 feet above mean sea level.

Started: June 26, 1980. Completed: June 26, 1980.

Total depth: 302.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Road fill.....	0.0	- 3.0
Silt, yellowish brown.....	3.0	- 33.0
Silt, reddish brown.....	33.0	- 39.0
Clay, reddish brown.....	39.0	- 41.0
Silt, reddish brown, clayey.....	41.0	- 47.0
Silt, yellowish brown, clayey.....	47.0	- 64.5
Silt, reddish brown, clayey.....	64.5	- 69.0
Silt, yellowish brown, clayey.....	69.0	- 77.0
Silt, reddish brown, clayey.....	77.0	- 92.0
Clay, reddish brown, silty.....	92.0	- 107.0
Silt, light grayish brown, clayey.....	107.0	- 128.0
Silt, light greenish brown, clayey; contains sand, very fine to fine.....	128.0	- 135.5
Sand, very fine to coarse.....	135.5	- 145.0
Clay, light gray.....	145.0	- 152.0
Clay, light gray; contains sand, very fine to medium.....	152.0	- 155.0
Sand, very fine to very coarse; contains gravel, very fine to coarse.....	155.0	- 164.0
Clay, light gray.....	164.0	- 170.0
Clay, dark gray.....	170.0	- 182.0
Sand, very fine to medium.....	182.0	- 191.2
Pennsylvanian System - Missouri Series - Kansas City Group:		
Wyandotte Formation:		
Argentine Member:		
Limestone, medium gray, very finely crystal- line; contains fusulinids, and marcasite....	191.2	- 194.8
Limestone, medium to dark gray, very finely crystalline; contains fusulinids.....	194.8	- 197.3
Shale, dark gray, interbedded with limestone, dark gray; contains fusulinids.....	197.3	- 199.1
Limestone, dark gray, very finely crystal- line; contains crinoids and fusulinids.....	199.1	- 199.8
Limestone, medium to dark gray, very finely crystalline; contains crinoids, and "black inclusions".....	199.8	- 200.5
Limestone, dark gray, very finely crystal- line, interbedded with shale, dark gray....	200.5	- 201.1
Limestone, medium to dark gray, very finely crystalline; interbedded with shale, medium to dark gray.....	201.1	- 201.7
Limestone, dark gray, very finely crystal- line, interbedded with shale, dark gray....	201.7	- 202.4
Limestone, dark gray, very finely crystalline; contains crinoids, and <u>Osagia</u>	202.4	- 203.4
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	203.4	- 207.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, dark gray, very finely crystal- line, interbedded with shale, dark gray.....	207.0	- 207.4
Quindaro Member:		
Shale, black.....	207.4	- 209.6
Shale, dark gray.....	209.6	- 210.0
Frisbie Member:		
Limestone, brownish gray, very finely crystal- line; contains fusulinids, brachiopods, and <u>Osagia</u>	210.0	- 210.8
Lane Formation:		
Shale, medium to dark gray.....	210.8	- 211.0
Limestone, dark gray, very finely crystal- line; contains abundant fusulinids, crinoids, and pyrite.....	211.0	- 211.4
Shale, medium to dark gray; contains brachio- pods.....	211.4	- 216.0
Shale, medium gray.....	216.0	- 218.9
Shale, red.....	218.9	- 219.1
Shale, dark gray.....	219.1	- 219.2
Shale, medium to dark gray.....	219.2	- 219.3
Iola Formation:		
Raytown Member:		
Limestone, light gray, very finely crystal- line.....	219.3	- 220.0
Shale, medium gray.....	220.0	- 221.7
Limestone, light gray, very finely crystal- line; contains fusulinids, and crinoids.....	221.7	- 223.0
Limestone, brownish gray, very finely crystalline; contains fusulinids, crinoids, brachiopods, and <u>Osagia</u>	223.0	- 223.8
Limestone, light brownish gray, very finely crystalline.....	223.8	- 225.0
Limestone, light brownish gray, very finely crystalline, interbedded with shale, dark gray.....	225.0	- 225.1
Limestone, light brownish gray, very finely crystalline.....	225.1	- 226.8
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	226.8	- 227.4
Shale, medium to dark gray.....	227.4	- 228.0
Limestone, brownish gray, very finely crystal- line; contains crinoids, algal material, <u>Osagia</u> , and glauconite.....	228.0	- 228.5
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	228.5	- 229.0
Chanute Formation:		
Shale, dark gray.....	229.0	- 230.1
Shale, black.....	230.1	- 230.8
Shale, dark gray.....	230.8	- 230.9

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium to dark gray.....	230.9	- 236.2
Drum Formation:		
Shale, medium gray, interbedded with lime- stone, medium gray.....	236.2	- 237.9
Limestone, brownish gray, very finely crystal- line; contains <u>Osagia</u> , and algal material...	237.9	- 238.7
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	238.7	- 241.1
Limestone, brownish gray, very finely crystal- line; contains pseudo-oolites, <u>Osagia</u> , and fusulinids.....	241.1	- 242.2
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray...	242.2	- 244.1
Limestone, dark gray, very finely crystal- line; contains algal material.....	244.1	- 245.2
Shale, medium to dark gray.....	245.2	- 245.6
Limestone, dark gray, very finely crystalline.	245.6	- 245.7
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray.....	245.7	- 246.7
Quivira Formation:		
Shale, medium to dark gray.....	246.7	- 248.0
Shale, dark gray.....	248.0	- 249.0
Sarpy Formation:		
Westerville Member:		
Limestone, dark gray, very finely crystalline; contains fusulinids.....	249.0	- 249.5
Shale, dark gray.....	249.5	- 251.0
Limestone, dark gray, irregular crystalline; contains fusulinids, crinoids, pseudo- oolites, and pyrite.....	251.0	- 251.9
Limestone, medium gray, very finely crystal- line; contains <u>Osagia</u> and algal material....	251.9	- 253.6
Limestone, light gray, very finely crystal- line.....	253.6	- 257.0
Limestone, light to medium gray, very finely crystalline.....	257.0	- 257.9
Wea Member:		
Shale, medium gray.....	257.9	- 259.0
Shale, dark gray.....	259.0	- 259.5
Shale, black.....	259.5	- 261.2
Fontana Formation:		
Shale, dark gray.....	261.2	- 261.6
Shale, medium gray.....	261.6	- 269.3
Shale, greenish gray.....	269.3	- 271.0
Shale, light to medium gray.....	271.0	- 272.3
Dennis Formation:		
Winterset Member:		

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, medium gray, very finely crystalline; contains fusulinids, brachiopods, algal material and pyrite.....	272.3	- 274.2
Limestone, light to medium gray, very finely crystalline; contains fusulinids, crinoids, and algal material.....	274.2	- 274.8
Limestone, light gray, very finely crystalline; contains brachiopods, fusulinids, pyrite, and marcasite.....	274.8	- 276.0
Limestone, light brownish gray, very finely crystalline; contains chert.....	276.0	- 289.2
Shale, medium gray.....	289.2	- 290.0
Limestone, light brownish gray, irregular crystalline; contains chert and pyrite.....	290.0	- 293.0
Shale, medium gray.....	293.0	- 293.1
Limestone, light brownish gray, very finely crystalline; contains chert and pyrite.....	293.1	- 294.0
Stark Member:		
Shale, light gray.....	294.0	- 295.4
Shale, dark gray.....	295.4	- 295.5
Shale, black.....	295.5	- 298.1
Shale, dark gray.....	298.1	- 298.2
Canville Member:		
Limestone, medium to dark gray, very finely crystalline; contains pyrite, fusulinids, and crinoids.....	298.2	- 298.9
Galesburg Formation:		
Shale, medium gray.....	298.9	- 301.2
Swope Formation:		
Bethany Falls Member:		
Limestone, light gray, very finely crystalline; contains crinoids, algal material, marcasite, and pyrite.....	301.2	- 302.0

Test Hole 34-80

Location: Sarpy County, SE SE SE SW sec. 15, T. 13 N., R. 13 E., approximately 81 feet north of south section line, and 2500 feet east of west section line.

Ground-level elevation: 1025.0 feet above mean sea level.

Started: June 27, 1980. Completed: June 27, 1980.

Total depth: 152.0 feet.

Description	Depth, in feet	
	From	To
Quaternary System:		
Clay, dark gray.....	0.0	- 4.5
Clay, medium to dark brown.....	4.5	- 9.0
Clay, dark greenish gray.....	9.0	- 40.0
Clay, dark gray, silty.....	40.0	- 45.0
Clay, olive gray; contains sand, medium.....	45.0	- 53.3
Pennsylvanian System - Missouri Series - Lansing Group:		
Stanton Formation:		
Stoner Member:		
Limestone, dark brownish gray, irregular crystalline; contains algal material.....	53.3	- 53.5
Eudora Member:		
Shale, olive gray.....	53.5	- 57.3
Captain Creek Member:		
Limestone, olive gray, very finely crystalline; contains bryozoans, algal material, and fusulinids.....	57.3	- 58.5
Vilas Formation:		
Shale, olive gray.....	58.5	- 64.5
Shale, olive gray, interbedded with limestone, olive gray.....	64.5	- 65.8
Plattsburg Formation:		
Limestone, orange gray, irregular crystalline; contains fusulinids, <u>Osagia</u> , and brachiopods.....	65.8	- 67.7
Limestone, orange gray, interbedded with shale, light gray.....	67.7	- 72.5
Limestone, dark gray, very finely crystalline.....	72.5	- 75.4
Limestone, medium to dark gray, very finely crystalline; contains fusulinids and crinoids.....	75.4	- 76.6
Limestone, medium gray, very finely crystalline; contains crinoids, and "black inclusions".....	76.6	- 77.1
Limestone, dark gray, very finely crystalline, interbedded with shale, dark gray....	77.1	- 81.0
Kansas City Group:		
Bonner Springs Formation:		
Shale, medium gray.....	81.0	- 82.8
Shale, red.....	82.8	- 84.5
Shale, greenish gray.....	84.5	- 86.2
Shale, light greenish gray.....	86.2	- 88.9
Wyandotte Formation:		
Farley Member:		
Limestone, light greenish gray, very finely crystalline; contains fusulinids, algal material, and glauconite.....	88.9	- 90.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light greenish gray, very finely crystalline, interbedded with shale, light greenish gray.....	90.8	- 92.0
Limestone, light brownish gray, irregular crystalline; contains algal material, fusulinids, and glauconite.....	92.0	- 93.5
Shale, dark greenish gray.....	93.5	- 94.3
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> , and glauconite.....	94.3	- 96.1
Limestone, light gray, very finely crystalline, interbedded with shale, greenish gray.	96.1	- 98.0
Island Creek Member:		
Shale, medium to dark greenish gray, interbedded with limestone, light gray.....	98.0	- 100.1
Argentine Member:		
Limestone, light gray, very finely crystalline; contains brachiopods, fusulinids, crinoids, and <u>Osagia</u>	100.1	- 101.4
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> , fusulinids, and crinoids.....	101.4	- 101.5
Limestone, light gray, very finely crystalline; contains <u>Osagia</u> and fusulinids.....	101.5	- 107.0
Limestone, light to medium gray, very finely crystalline; contains <u>Osagia</u> , and fusulinids.....	107.0	- 110.8
Shale, medium gray.....	110.8	- 112.3
Limestone, dark gray, very finely crystalline, interbedded with shale, medium gray...	112.3	- 113.9
Limestone, dark gray, very finely crystalline; contains crinoids, fusulinids, and brachiopods.....	113.9	- 116.8
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	116.8	- 119.0
Quindaro Member:		
Shale, black.....	119.0	- 120.5
Shale, medium gray.....	120.5	- 121.0
Frisbie Member:		
Limestone, dark gray, very finely crystalline; contains pseudo-oolites, crinoids, and fusulinids.....	121.0	- 122.8
Lane Formation:		
Shale, dark gray.....	122.8	- 125.0
Shale, greenish gray.....	125.0	- 126.5
Shale, red.....	126.5	- 128.4
Shale, dark gray.....	128.4	- 129.3
Iola Formation:		
Raytown Member:		
Limestone, light tannish gray, very finely crystalline; contains <u>Osagia</u>	129.3	- 130.4

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Limestone, light gray, very finely crystalline, interbedded with shale, light gray....	130.4	- 132.3
Limestone, light gray to dark greenish gray, very finely crystalline.....	132.3	- 133.9
Limestone, light brownish gray, irregular crystalline; contains fusulinids, and glauconite.....	133.9	- 137.2
Shale, medium to dark gray.....	137.2	- 138.1
Limestone, light brownish gray, very finely crystalline; contains fusulinids, crinoids, and glauconite.....	138.1	- 138.3
Chanute Formation:		
Shale, medium to dark gray.....	138.3	- 140.4
Shale, black.....	140.4	- 142.0
Shale, greenish gray.....	142.0	- 144.8
Drum Formation:		
Limestone, medium to dark brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids, and <u>Osagia</u>	144.8	- 147.7
Limestone, light brownish gray, very finely crystalline; contains pseudo-oolites, fusulinids, brachiopods, and crinoids.....	147.7	- 152.0

Test Hole 35-80

Location: Sarpy County, SE SW NW SW sec. 28, T. 14 N., R. 13 E., approximately 1500 feet north of south section line, and 700 feet east of west section line.

Ground-level elevation: 1040.0 feet above mean sea level.

Started: June 25, 1980. Completed: June 25, 1980.

Total depth: 70.4 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, brownish gray, clayey.....	0.0	- 27.0
Silt, reddish brown, clayey.....	27.0	- 35.0
Clay, reddish brown.....	35.0	- 52.0
Clay, reddish brown; contains sand, very fine.	52.0	- 61.5
Clay, reddish brown; contains sand, very fine to medium.....	61.5	- 62.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Sand, very fine to coarse.....	62.0	- 70.0
Pennsylvanian System - Missouri Series - Lansing Group:		
Stanton Formation:		
Stoner Member:		
Limestone, orange, very finely crystalline; contains pseudo-oolites.....	70.0	- 70.4

Test Hole 36-80

Location: Cass County, NW NW SW SW sec. 1, T. 12 N., R. 13 E.,
approximately 1000 feet north of south section line,
and 150 feet east of west section line.

Ground-level elevation: 1012.0 feet above mean sea level.

Started: June 28, 1980. Completed: June 28, 1980.

Total depth: 152.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, dark brown.....	0.0	- 14.5
Silt, medium brown, clayey.....	14.5	- 17.0
Silt, light to medium brown, clayey.....	17.0	- 23.0
Silt, medium gray, clayey.....	23.0	- 36.5
Silt, medium gray, clayey; contains gravel coarse.....	36.5	- 38.0
Pennsylvanian System - Virgil Series - Shawnee Group:		
Oread Formation:		
Toronto Member:		
Limestone, orange gray, very finely crystal- line; contains pseudo-oolites, crinoids, fusulinids, and brachiopods.....	38.0	- 39.1
Shale, greenish gray.....	39.1	- 39.9
Limestone, orange gray, very finely crystal- line; contains fusulinids, crinoids, and brachiopods.....	39.9	- 41.0
Limestone, light gray, very finely crystal- line; contains fusulinids, and crinoids.....	41.0	- 41.9

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray.....	41.9	- 42.0
Limestone, medium gray, very finely crystal- line, interbedded with shale, medium gray; contains <u>Osagia</u> , fusulinids, brachiopods, and crinoids.....	42.0	- 47.0
Douglas Group:		
Lawrence Formation:		
Shale, medium gray.....	47.0	- 47.5
Shale, red.....	47.5	- 51.4
Shale, red, with gray mottling.....	51.4	- 53.8
Shale, red.....	53.8	- 57.5
Shale, red, with gray mottling.....	57.5	- 58.5
Shale, medium gray.....	58.5	- 66.4
Shale, dark gray.....	66.4	- 85.0
Shale, olive gray.....	85.0	- 87.7
Shale, dark gray.....	87.7	- 91.8
Cass Formation:		
Haskell Member:		
Limestone, dark gray, very finely crystal- line; contains crinoids, fusulinids, and brachiopods.....	91.8	- 92.3
Shale, dark gray.....	92.3	- 93.0
Limestone, dark gray, very finely crystal- line; contains crinoids, and fusulinids.....	93.0	- 96.0
Little Pawnee Member:		
Shale, dark gray.....	96.0	- 97.7
Shale, black.....	97.7	- 97.9
Shale, dark gray.....	97.9	- 98.1
Shoemaker Member:		
Limestone, dark gray, very finely crystal- line; contains crinoids.....	98.1	- 99.4
Plattford Formation:		
Unnamed Member:		
Shale, dark gray.....	99.4	- 104.9
Shale, dark greenish gray.....	104.9	- 107.0
Shale, medium to dark greenish gray.....	107.0	- 108.5
Shale, medium to dark gray.....	108.5	- 110.0
Shale, medium gray.....	110.0	- 111.1
Nehawka Member:		
Limestone, light brownish gray, very finely crystalline.....	111.1	- 112.7
Limestone, light brownish gray, very finely crystalline, interbedded with shale, medium gray.....	112.7	- 118.4
Unnamed Member:		
Shale, medium gray, interbedded with lime- stone, medium gray.....	118.4	- 119.8
Shale, medium gray.....	119.8	- 121.8

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Missouri Series - Lansing Group:		
Stanton Formation:		
South Bend Member:		
Limestone, light brownish gray to white, irregular crystalline; contains pseudo-oolites, <u>Osagia</u> , fusulinids, chert, and pyrite.....	121.8	- 124.1
Shale, medium gray.....	124.1	- 125.4
Shale, dark gray.....	125.4	- 129.1
Limestone, dark brownish gray, very finely crystalline; contains pseudo-oolites, crinoids, <u>Osagia</u> , and fusulinids.....	129.1	- 129.3
Shale, dark gray.....	129.3	- 129.8
Limestone, dark brownish gray, very finely crystalline; contains fusulinids, crinoids, and glauconite.....	129.8	- 131.1
Rock Lake Member:		
Shale, greenish gray.....	131.1	- 136.0
Stoner Member:		
Limestone, light brownish gray, very finely crystalline, interbedded with shale, greenish gray.....	136.0	- 137.0
Shale, greenish gray, interbedded with limestone, light brownish gray.....	137.0	- 139.9
Limestone, light brownish gray, very finely crystalline; contains pyrite.....	139.9	- 143.0
Limestone, light brownish gray, irregular crystalline; contains fusulinids, and crinoids.....	143.0	- 144.8
Limestone, light to medium gray, very finely crystalline; contains fusulinids.....	144.8	- 147.0
Shale, medium to dark gray.....	147.0	- 152.0

Test Hole 37-80

Location: Cass County, NE NE SW NE sec. 14, T. 12 N., R. 13 E., approximately 26 feet south of quarter section line, and 1100 east of half section line.

Ground-level elevation: 1125.0 feet above mean sea level.

Started: June 29, 1980. Completed: June 29, 1980.

Total depth: 182.0 feet.

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Quaternary System:		
Silt, medium brown, clayey.....	0.0	- 14.0
Silt, black.....	14.0	- 15.0
Silt, dark brown, clayey.....	15.0	- 22.0
Clay, olive gray.....	22.0	- 28.0
Silt, dark brown, clayey.....	28.0	- 29.0
Silt, yellowish brown, clayey.....	29.0	- 34.0
Silt, reddish brown, clayey.....	34.0	- 38.0
Clay, reddish brown.....	38.0	- 52.0
Clay, yellowish brown; contains sand, very fine to fine.....	52.0	- 57.0
Clay, olive gray; contains sand, very fine to fine.....	57.0	- 64.0
Clay, dark yellowish gray.....	64.0	- 67.0
Clay, brownish gray; contains sand, very fine to medium.....	67.0	- 68.0
Clay, brownish gray.....	68.0	- 69.0
Sand, very fine to coarse.....	69.0	- 70.0
Clay, yellowish brown.....	70.0	- 73.0
Clay, medium gray.....	73.0	- 81.0
Pennsylvanian System - Virgil Series - Shawnee Group:		
Oread Formation:		
Kereford Member:		
Limestone, light brownish gray, very finely crystalline; contains fusulinids.....	81.0	- 82.1
Limestone, orange gray, very finely crystalline; contains abundant fusulinids, and <u>Osagia</u>	82.1	- 82.6
Limestone, medium gray, very finely crystalline; contains abundant fusulinids.....	82.6	- 83.5
Heumader Member:		
Shale, medium gray; contains abundant fusulinids.....	83.5	- 84.0
Shale, dark gray; contains abundant fusulinids.....	84.0	- 84.2
Plattsmouth Member:		
Limestone, medium to dark gray, very finely crystalline; contains fusulinids, crinoids, <u>Osagia</u> , algal material, and pyrite.....	84.2	- 86.6
Limestone, brownish gray, irregular crystalline; contains pseudo-oolites, fusulinids, <u>Osagia</u> , algal material, pyrite, and glauconite.....	86.6	- 87.1
Limestone, dark gray, very finely crystalline; contains fusulinids, and chert.....	87.1	- 91.0
Limestone, brownish gray, very finely crystalline; contains fusulinids, and chert.	91.0	- 92.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Shale, medium gray, with interbedded limestone, medium gray.....	92.0	- 92.8
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	92.8	- 94.1
Heebner Member:		
Shale, dark gray.....	94.1	- 95.2
Shale, black fissile.....	95.2	- 98.3
Leavenworth Member:		
Limestone, medium gray, very finely crystalline; contains fusulinids.....	98.3	- 99.7
Snyderville Member:		
Shale, medium gray.....	99.7	- 102.8
Shale, light greenish gray.....	102.8	- 118.8
Toronto Member:		
Limestone, light brownish gray, very finely crystalline, interbedded with shale, greenish gray.....	118.8	- 119.4
Limestone, light tannish gray, very finely crystalline; contains fusulinids, and <u>Osagia</u>	119.4	- 121.2
Limestone, light tannish gray, very finely crystalline, interbedded with shale, greenish gray.....	121.2	- 121.5
Limestone, light gray, very finely crystalline; contains crinoids, fusulinids, pyrite, and glauconite.....	121.5	- 122.9
Limestone, light gray, very finely crystalline, interbedded with shale, medium gray...	122.9	- 124.1
Limestone, medium gray, very finely crystalline, interbedded with shale, medium gray...	124.1	- 124.3
Shawnee Group:		
Lawrence Formation:		
Shale, medium gray.....	124.3	- 126.0
Shale, red.....	126.0	- 131.5
Shale, medium to dark gray.....	131.5	- 133.3
Limestone, brownish gray, very finely crystalline.....	133.3	- 133.5
Shale, medium gray, with red mottling.....	133.5	- 135.0
Shale, red.....	135.0	- 138.5
Shale, medium gray.....	138.5	- 140.0
Limestone, medium gray, very finely crystalline.....	140.0	- 140.5
Shale, medium gray.....	140.5	- 146.2
Shale, dark gray.....	146.2	- 147.0
Shale, medium to dark gray.....	147.0	- 152.0
Shale, dark gray.....	152.0	- 164.5
Shale, medium to dark gray.....	164.5	- 165.5
Shale, olive gray.....	165.5	- 170.0
Shale, dark gray.....	170.0	- 173.0

<u>Description</u>	<u>Depth, in feet</u>	
	<u>From</u>	<u>To</u>
Cass Formation:		
Haskell Member:		
Limestone, dark gray, very finely crystalline; contains crinoids, algal material, pyrite, and glauconite.....	173.0	- 173.9
Shale, dark gray.....	173.9	- 174.5
Limestone, dark gray, very finely crystal- line; contains crinoids, algal material, pyrite, and glauconite.....	174.5	- 177.8
Little Pawnee Member:		
Shale, dark gray.....	177.8	- 178.2
Shale, black.....	178.2	- 179.0
Shale, dark gray.....	179.0	- 179.4
Shoemaker Member:		
Limestone, dark gray, very finely crystal- line; contains crinoids, and algal material.	179.4	- 182.1
Plattford Formation:		
Unnamed Member:		
Shale, dark gray.....	182.1	- 182.0

NRC FORM 335 (7-77)		U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET		1. REPORT NUMBER <i>(Assigned by DDC)</i> NUREG/CR-2132	
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16. ABSTRACT <i>(200 words or less)</i> This annual report presents and interprets the information obtained by the Conservation and Survey Division (Nebraska Geological Survey) during contract year July 1, 1979, to June 30, 1980, under contract NRC-04-76-315 with the U.S. Nuclear Regulatory Commission. The information pertains to the geology, structure, tectonics and seismicity of eastern Nebraska with emphasis on the vicinity south of Omaha, Nebraska. Some of the information presented here results from a combination of studies begun in earlier years but the greater part results from studies begun during the contract year. The scope of the studies is summarized as follows: 1. Rock outcrops in northeastern Cass, eastern Sarpy, and southeastern Douglas counties were reexamined and reevaluated and 39 test holes were drilled to determine the altitude of the upper surface of the Winterset Limestone of Pennsylvanian age: 2. One new seismograph was installed in eastern Nebraska: 3. Gravity surveys in eastern Nebraska were extended: 4. Ground magnetic surveys in northeastern Cass and eastern Sarpy counties were made and evaluated. Discussion of the results of these studies constitute the remainder of this report.					
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